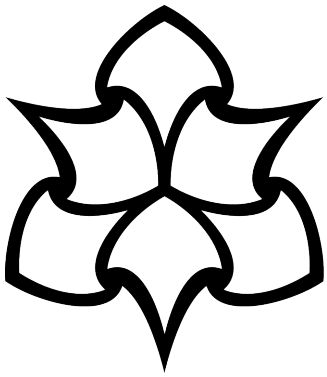

An exploration of factors to improve outcomes in the area of AAC interventions for children with ASC

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An exploration of factors to improve outcomes in the area of AAC interventions for children with ASC

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Dedication

For Dad with love.

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Abstract

Many children with a diagnosis of autism spectrum condition fail to develop functional speech. For these children, augmentative and alternative communication (AAC) is often considered as an intervention to support expressive communication. Research has shown that children with autism spectrum condition can learn to use aided AAC systems to request although there are still gaps in the knowledge base to support clinicians to make decisions about AAC interventions. This research aims to answer the overarching question pertaining to how can speech and language therapists can improve clinical outcomes when providing AAC interventions for children with ASC. To answer this question, a multi-faceted view of the AAC assessment and intervention process was taken. Specifically, this research sought to answer three questions; firstly, how do two visual display layouts: a visual scene display or a grid display, impact on how minimally verbal children with ASC learn to request using a VOCA? Secondly, how do the individual characteristics of children with ASC impact on their learning to use VOCAs? And thirdly, what aspects of AAC interventions should be considered during the decision-making process for children with ASC?

A mixed methods research methodology was chosen to answer the overarching question. This included a series of four studies. Studies 1 and 2 were single case experimental designs in which a total of eight young children with ASC were taught to request using a voice output communication aid. A comparison was made between two types of vocabulary layout; a grid display and a visual scene display. In Study 2, in addition to the AAC intervention, sensory processing interventions were also provided as all the participants also had a diagnosis of sensory processing difficulties. Study 3 was a qualitative study in which the occupational therapist who supported the provision of interventions in Study 1 and Study 2 was interviewed. Study 4 was a mixed methods study consisting of another single case experimental design in which a further four children were

taught to request with a voice output communication aid using AAC intervention combined with sensory processing interventions. The qualitative strand was a focus group of AAC clinicians who observed the interventions and which therefore served to provide insights into how interventions were provided. The results indicated that there was similar progress in learning to request with a VOCA regardless of which vocabulary layout was used. When child characteristics were examined, children who had a hypo-reactive or seeking sensory processing pattern appeared to take the longest to learn to use to request. Furthermore, these children also had the lowest levels of adaptive functioning, receptive language, and social communicative skills at the outset of the study. The results also indicated that the bond between clinician and child was important and that the clinician needed to adapt according to the child's individual characteristics. Clinical implications of the research point to the need to provide interventions according to the child's characteristics including sensory processing. Further clinical implications of the results refer to the AAC device itself, and suggestions as to how the interventions can be implemented. Further research on how sensory processing difficulties impact learning to use AAC systems is recommended. It is also suggested that research on how clinicians bond with children with ASC during the AAC intervention process is needed.

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List of Abbreviations

Abbreviation	Explanation
AAC	Augmentative and Alternative Communication
ACTU	Access to Communication and Technology Unit
App	Application
ABA	Applied behaviour analysis
ATD	Alternating treatment design
AATD	Adapted alternating treatments design
ADOS-2	Autism Diagnostic Observation Schedule: Second Edition
ASC	Autism Spectrum Condition
ASI	Ayres Sensory Integration®
CDI-III	McArthur-Bates Communicative Development Inventories: Third Edition
DSOR	Direct Systematic Observational Recording
ICF	International Classification of Functioning, Disability and Health
MBD	Multiple baseline design
MPD	Multiple probe design
OT	Occupational Therapist
PCS	Picture Communication System
PECS	Picture Exchange Communication System
PND	Percentage of nonoverlapping points
RCT	Randomised Control Trial
RSB	Repetitive and stereotyped behaviour
SCED	Single Case Experimental Design
SLT	Speech and Language Therapist
SSP	Short Sensory Profile
TARF-R	Treatment Acceptability Rating Scale-Revised
VABS-2	Vineland Adaptive Behaviour Scales-Second Edition
VOCA	Voice output communication aid
VSD	Visual scene display

Introduction

According to recent figures, one in 59 children receive a diagnosis of autism spectrum condition (ASC; Baio et al., 2018). Difficulties with communication, in particular social communication are a primary feature of the medical diagnosis for these children (American Psychiatric Association, 2013). As a result, therefore, there is an increased risk that their ability to participate in society will be impeded as communication skills are of crucial importance to social participation, learning, independence, and employability (Light, 1997; Romski and Sevcik, 2005; Light and McNaughton, 2012a).

Augmentative and alternative communication (AAC) is reported to be a promising area of practice which can support children with communication needs to build communicative competence. This is achieved through the use of different communication modalities, such as manual signs, communication books, and voice output communication aids (VOCAs; Light et al., 2019a). There is a body of evidence that demonstrates the positive effects of AAC specifically with children with ASC, for example, Schlosser et al (2009); Wendt (2009); Ganz et al. (2012b) and Schlosser and Koul (2015). Despite this evidence, however, Ganz (2015) highlights the need for further research in the area of such interventions for children diagnosed with ASC due to the likelihood of their need for AAC interventions and the potential impact of long term communication difficulties. This is considered to be urgent when the increasing prevalence rates of ASC are considered (Baio et al., 2018).

The present thesis focuses on some of the factors which could improve outcomes in the area of AAC interventions for preschoolers who are diagnosed with ASC. The research focuses on three aspects of AAC interventions: the technology itself, the characteristics of children with ASC that could have an impact on AAC interventions, and characteristics of the speech and language therapist (SLT) that could also influence the outcomes of AAC interventions with children with ASC.

Much of the research to date has focused on feature matching the AAC system to the child with ASC e.g., choosing between a paper based system such as a communication board or a high tech AAC system such as an iPad with an AAC application (app) which can generate voice output. The initial focus of this thesis considers how the vocabulary can be organised on the display of a voice output communication aid (VOCA) to support learning to request desired items. Specifically, comparisons are made between grid displays and visual scene displays (VSDs). Identifying the AAC system which best matches the child's needs is, however, only one part of the solution, clinicians need to also consider how the child will successfully be taught to use the system (Beukelman, 1991). Further aspects of the thesis explore the possibility that sensory processing difficulties, which are highly prevalent in children with ASC, could impact learning to use AAC systems and how this could be incorporated into AAC interventions. The final aspect of the thesis considers how the SLT's ability to build a therapeutic relationship with a child with ASC acts as a foundation to the successful implementation of AAC interventions with this client group. These considerations attempt to explain many aspects of the AAC intervention process relevant to preschool children with a medical diagnosis of ASC.

The research presented in the present thesis is important because children with ASC present with social communication difficulties which oftentimes sets them apart from other children with disabilities who benefit from AAC interventions (Ganz, 2015). Children with ASC may not have the inherent understanding and interest in communicating that other children with differing communication disabilities/SLT diagnoses have and this means that SLTs may need to adapt the decision-making process for this client group (Lund et al., 2017). Consequently, this suggests that SLTs would benefit from research which would support them to make evidence based assessment and intervention decisions in the context of AAC interventions for this client group.

The overarching research question for this thesis was:

> How can SLTs improve outcomes when making decisions for AAC interventions for children with ASC?

The sub questions were:

1. How do two visual display layouts: a VSD or a grid display, impact on how minimally verbal children with ASC learn to request using a VOCA?
2. How do the individual characteristics of children with ASC impact on their learning to use VOCAs?
3. What aspects of AAC interventions should be considered during the decision-making process for children with ASC?

The research presented in this thesis utilised a combination of quantitative and qualitative research methods in order to answer the overarching research question. This included the use of single case experimental designs (SCEDs), interview and focus group research methodologies.

Thesis structure

The thesis structure demonstrates the exploratory nature of this study, utilising a mixed methods approach to data collection and analysis. Chapter 1 presents an overview of the literature in relation to children with ASC: AAC systems that are recognised as useful with this client group, the impact of child characteristics including sensory processing patterns on AAC use, and the influence of therapeutic relationships within the intervention process. The resultant research activity is carried out in four phases, therefore the methodology for each of these phases is presented separately in Chapter 2. Chapters 3 to 6 describe the implementation, results and discussion for each of the four studies. Chapter 3 presents Study 1, which is a single SCED and addresses research question 1. It compares the impact of display layouts: a visual scene display and grid display on a voice output communication aid to teach requesting to four participants with

ASC. Research question 2 is also partly answered through Study 1 as participant characteristics are utilised to provide possible explanations of the results. Study 2 is described in Chapter 4, also a SCED which was designed to contribute further data required to answer research question 1. Study 2 therefore compares a visual scene display with a grid display on a VOCA. In addition, the child characteristics of the four participants in Study 2 were utilised to provide a contribution to the explanation of the results and is therefore also relevant to research question 2. As all participants had identified sensory processing difficulties as well as ASC this provides further insight into the impact of child characteristics on learning to request with a voice output communication aid which is also utilised to answer to research question 2. In Study 2, to support learning of the AAC systems, sensory processing interventions are planned and implemented alongside SLT clinically informed AAC interventions. Study 3 is detailed in Chapter 5. This qualitative study involves an interview methodology. Here, an occupational therapist who co-implemented the interventions in Studies 1 and 2 was interviewed for her opinions on providing AAC interventions to children with a diagnosis of ASC. This study was designed to provide data which was utilised to inform all three research questions. Study 4 is described in Chapter 6. This was designed as a mixed methods study involving a SCED and focus group methodology the goals of which were to answer research questions 2 and 3. In Study 4, the SCED included a further four children with ASC and sensory processing difficulties who were taught to request with a grid display. To facilitate the focus group component of Study 4, intervention sessions were observed by two SLTs and one occupational therapist who agreed to contribute to a focus group discussion following the completion of the child-intervention elements. In the discussion they considered the techniques utilised by the therapists who implemented the interventions with the children with ASC. The final chapter, Chapter 7, is a discussion of the results from Studies 1-4. Clinical implications of the findings are presented alongside the strengths and limitations of this thesis. Further avenues for research are suggested.

Chapter 1. Literature review

1.1 Autistic spectrum condition

Autism spectrum condition (ASC) is a neurodevelopmental disorder which is both complex and multi-faceted (Hirtz et al., 2017). When autism was first described by Kanner (1943), it was considered to be a rare disorder with an estimated prevalence of two to five per 10,000 children. Today, ASC is one of the most common developmental disabilities diagnosed in children, with recent estimates of prevalence estimated at one in 59 (Baio et al., 2018). Previous prevalence estimates were lower, for example, the prevalence of ASC in 2010 was estimated to be one in 68 suggesting that the incidence of ASC appears to be on the rise (Baio et al., 2018). While it is unclear if the rise in prevalence is due to an actual increase in the numbers of children who have ASC or due to changes in practice such as improved processes of diagnosis, heightened awareness and earlier screening, it is clear that there is an increased demand for evidence based interventions which could potentially mitigate against the core deficits associated with ASC (Smith and Iadarola, 2015).

Children diagnosed with autism may present with cognitive impairments as well as deficits in the area of adaptive behaviour (Volkmar et al., 1987). In this thesis, the term 'autism spectrum condition' (ASC) is utilised in preference to autism spectrum disorder as it reflects both the areas of cognitive strength exhibited by these individuals as well as the disabilities (Baron-Cohen et al., 2009). The American Psychiatric Association's 2013 release of Diagnostic and Statistical Manual of Mental Disorders (DSM-5) provides standardised criteria which are utilised by professionals to make this diagnosis. According to the fifth edition of the DSM, which refers to autism spectrum disorder, the defining characteristics of ASC are classified into two domains. These are, firstly, impairments in social interaction and social communication, and secondly, the presence of restricted, repetitive patterns of behaviour, interests, or activities (Table 1.1; American Psychiatric Association, 2013).

Table 1.1 DSM-5 diagnostic criteria for autism spectrum disorder

Autism Spectrum Condition

Must meet criteria A, B, C, and D:

A. Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following, currently or by history (examples are illustrative, not exhaustive, see text):

1. Deficits in social-emotional reciprocity, ranging, for example, from abnormal social approach and failure of normal back-and-forth conversation; to reduced sharing of interests, emotions, or affect; to failure to initiate or respond to social interactions.

2. Deficits in nonverbal communicative behaviours used for social interaction, ranging, for example, from poorly integrated verbal and nonverbal communication; to abnormalities in eye contact and body language or deficits in understanding and use of gestures; to a total lack of facial expressions and nonverbal communication.

3. Deficits in developing, maintaining, and understanding relationships, ranging, for example, from difficulties adjusting behaviour to suit various social contexts; to difficulties in sharing imaginative play or in making friends; to absence of interest in peers.

B. Restricted, repetitive patterns of behaviour, interests, or activities, as manifested by at least two of the following, currently or by history (examples are illustrative, not exhaustive; see text):

1. Stereotyped or repetitive motor movements, use of objects, or speech (e.g., simple motor stereotypies, lining up toys or flipping objects, echolalia, idiosyncratic phrases).

2. Insistence on sameness, inflexible adherence to routines, or ritualized patterns or verbal nonverbal behaviour (e.g., extreme distress at small changes, difficulties with transitions, rigid thinking patterns, greeting rituals, need to take same route or eat food every day).

3. Highly restricted, fixated interests that are abnormal in intensity or focus (e.g. strong attachment to or preoccupation with unusual objects, excessively circumscribed or perseverative interest).

4. Hyper- or hyporeactivity to sensory input or unusual interests in sensory aspects of the environment (e.g., apparent indifference to pain/temperature, adverse response to specific sounds or textures, excessive smelling or touching of objects, visual fascination with lights or movement).

C. Symptoms must be present in the early developmental period (but may not become fully manifest until social demands exceed limited capacities or may be masked by learned strategies in later life).

D. Symptoms cause clinically significant impairment in social, occupational, or other important areas of current functioning.

Adapted from American Psychiatric Association (2013)

1.1.1 Social communication

According to the DSM-5, deficits in social interaction and social communication include difficulties in three areas: social-emotional reciprocity, nonverbal communication skills which are used for social interactions, and the area of maintaining and building relationships with others. Zager et al. (2016) state that symptoms within the area of social-emotional reciprocity in very young children may include lack of and/or abnormal eye contact, lack of interest in interacting with other children with a preference for playing alone, and a lack of response to social stimuli Furthermore, pointing, giving and showing of objects to others may not be evident. In pre-schoolers, difficulties in social-emotional reciprocity may also include difficulties with taking turns in conversations, and an absence of/response to social interactions. In the area of non-verbal communication, it is possible that children with ASC may demonstrate difficulties with eye contact, body language, and facial expressions while understanding and use of gestures for communicative purposes may also be impaired. In terms of building relationships with others, children with ASC are often described as having a reduced interest in other people. Furthermore, children with ASC may have difficulty initiating and sharing in pretend play (Zager et al., 2016).

1.1.2 Restricted, repetitive patterns of behaviour and interests

In the DSM-5, the domain of restricted and repetitive patterns of behaviours and interests is divided into four areas: stereotyped or repetitive motor movements, inflexible adherence to routines and rituals, preoccupations and restricted interests, and sensory behaviours. Stereotypical behaviours refer to behaviours, which may be motor or vocal, and which do not appear to have an adaptive function (Matson et al., 1997). These may include repetitive hand and body movements including hand flapping, as well as spinning, rotating and exploring objects in a visual manner (Ozonoff et al., 2008; Kaur et al., 2015). A desire or an insistence for sameness is also frequently evident in this group of children (Leekam et al., 2007), and this may result in difficulties with transitioning from one activity to another and distress at small changes in routines (American

Psychological Association, 2013). Restricted interests in which children with ASC become preoccupied with specific interests and activities are frequently evident (Charman, 2008).

While, deficits in the area of socialisation and communication were consistently included in previous editions of the DSM, the diagnostic criteria for ASC in the DSM-5 makes reference to sensory reactivity which was previously referred to in the DSM-3 but not included in the DSM-4 (Green et al., 2016). Sensory reactivity, also referred to in the literature as sensory responsivity or sensory modulation is included in the restricted and repetitive behaviour domain of the DSM-5 and is one of four possible criteria of which two must be observed within this domain.

In Hazen et al.'s (2014) review of sensory symptoms in ASC, three categories of sensory modulation disorders are described. The term 'sensory modulation' refers to the ability to perceive information and generate a response which is appropriately graded to the situation (Ayres, 1972; McIntosh et al., 1999; Bar-Shalita et al., 2008). The first type of sensory modulation disorder refers to hyper-reactivity, in which a child displays a distressed or exaggerated response to sensory input. The second refers to hypo-reactivity. Children who present with hypo-reactive patterns are slow to respond to stimuli which would elicit a response in children who have typical sensory modulation. The final category of sensory modulation disorder is sensory seeking in which the child seeks or craves certain sensory experiences. In such instances, the child may exhibit a preoccupation with certain sensory experiences (Zager et al., 2016). According to Tavassoli et al. (2016), hyper-reactivity is referred to in the DSM-5 as 'adverse response to stimuli', hypo-reactivity as an 'indifference' to sensory stimuli, and sensory seeking as 'fascination with stimuli'.

Hazen et al. (2014) suggest that the inclusion of sensory symptoms within the DSM-5 indicates the possibility that these symptoms are more than a peripheral issue to ASC, but possibly central to the condition. Accumulating evidence

demonstrates that sensory symptoms contribute to the features of ASC (Hazen et al., 2014), and impact the ability to participate in many functional daily living activities (Ashburner et al., 2014).

1.1.3 Heterogeneity within ASC

ASC is a particularly heterogeneous condition as no two children with this diagnosis present the same way (Lord et al., 2000; Anagnostou et al., 2014). There may be variation in terms of cognitive skills and linguistic levels (Jones and Klin, 2009; Paul et al., 2013).

The wide variation found in ASC is evident both in terms of symptom severity and the functional impact of these symptoms and presents a challenge to both clinicians and researchers who are tasked with providing interventions which will result in positive outcomes to the entire spectrum of impairments associated with this diagnosis (Anagnostou et al., 2014).

1.1.4 Communication skills of children with ASC

Impairments in social interaction and social communication are considered to be a defining feature of ASC and the severity of these symptoms vary widely, yet children with ASC also exhibit great variation in their language and communication skills (Watson et al., 2011). It is therefore possible for a child with ASC to have well developed language skills yet still have difficulty with social communication (Watson et al., 2011).

Studies which have been designed to assess the prevalence of language delays in children with ASC have concluded that up to 30% may fail to develop functional speech (Anderson et al., 2007; Wodka et al., 2013; Rose et al., 2016). In the literature, the expressive language skills of children with ASC who use little or no spoken language has generally been referred to as 'minimally verbal' (Rose et al., 2016). For the purpose of this thesis, the term 'minimally verbal' is conceptualised as the use of less than 20 spoken words for functional purposes (Kasari et al.,

2013). Furthermore, functional verbal communication is defined as spoken language which is spontaneous and meaningful (Tager-Flusberg et al., 2009).

Research has indicated that children with ASC who remain minimally verbal are likely to experience poorer long term outcomes than children who develop functional verbal communication before the age of five (Patten et al., 2013). Specifically, children with ASC who develop verbal language before this age are likely to attain greater educational levels, and experience improved outcomes in terms of employability, independence, and building of social relationships (Kobayashi et al., 1992; Venter et al., 1992; Iacono et al., 2009; Mouga et al., 2015). While interventions aimed at teaching spoken language exist, and have been successful for some children with ASC, some children fail to acquire functional language even after intensive intervention (Lovaas, 1977). As communication difficulties can continue to have negative effects on a child's life, for example, through missed opportunities for interaction and learning, it is imperative that effective interventions are provided (Romski and Sevcik, 2005). For children with ASC who are minimally verbal, interventions to support expressive communication and thus develop communicative competence may be achieved through other forms of communication e.g., manual signs and picture based systems (Schlosser et al., 2009). The use of other forms of communication is generally referred to as augmentative and alternative communication (AAC) and it is generally accepted that some children with ASC may require AAC systems to support their communication development and thus develop functional communication (Mirenda, 2009).

1.2 What is AAC?

AAC refers to an area of educational and clinical practise which focuses on supplementing or replacing natural speech and/or handwriting when for some reason these are impaired and therefore cannot meet the individual's needs (Lloyd et al., 1998; Murray and Goldbart, 2009). AAC is often thought of as a system which is designed to support an individual to express themselves although it can

be used to support the understanding of language and communication (Judge et al., 2019). In the present research, the focus is on the use of AAC to support expressive communication.

There are many kinds of AAC which are generally categorised into unaided and aided communication (Romski and Sevcik, 2005; Communication Matters, 2018). Specifically, the term modality is utilised to refer to the mode of communication which can consist of speaking and writing as well as AAC modes such as manual signs, gestures, communication books, and AAC devices with voice output (Loncke et al., 2006). In a general sense, AAC is divided into two broad groups; aided and unaided AAC: according to whether or not the individual utilises external equipment to support communication (Communication Matters, 2018; American Speech-Language-Hearing Association, 2019a). It is possible that one mode of AAC may not meet all of an individual's communication needs and therefore multiple modes of communication are often utilised (Sigafoos and Drasgow, 2001).

As unaided communication does not involve the use of external equipment, the body is therefore used to support expressive communication. Unaided communication also referred to as no-tech communication includes the use of manual signing and gestures (Mirenda, 2009; American Speech-Language-Hearing Association, 2019b). Aided communication, on the other hand, involves the use of equipment external to the body such as communication boards and books, and voice output communication devices (VOCAs).

Aided communication systems typically include the representation of vocabulary through the use of visual graphic-symbols such as photographs, line drawings, letters, and text. Formalised symbol sets such as Picture Communication Symbols may also be utilised (Murray and Goldbart, 2009). The use of visual graphic symbols to represent spoken language is referred to as the language representation method (Mirenda, 2009; Murray and Goldbart, 2009; American

Speech-Language-Hearing Association, 2019b). von Tetzchner (2018) utilises the term graphic-symbol communication devices to refer to AAC devices which have a system of graphic-symbol embedded within. Aided communication systems are typically subdivided into low-tech and high-tech systems (Communication Matters, 2018; American Speech-Language-Hearing Association, 2019a).

Low-tech AAC systems are non-electronic and may include the use of objects, pictures, communication boards, and writing (American Speech-Language-Hearing Association, 2019a; Communication Matters, 2018). In contrast, high-tech AAC systems are electronic and emit voice output when activated by the user. von Tetzchner (2018) states that the graphic-symbol communication system within an aided communication device is designed for constructing utterances to be utilised in social interactions as well as fulfilling all or many of the functions of spoken language. It is therefore possible that both low-tech and high-tech AAC systems may potentially have similar capabilities from a communicative and linguistic perspective. Judge et al., (2019) note that the way that graphic-symbols are arranged within such devices is likely to impact on the individual's ability to construct language. Figure 1.1, adapted from the American Speech-Language-Hearing Association's (2019b) website presents an overview of the types of AAC with examples of the categorisation of AAC systems.

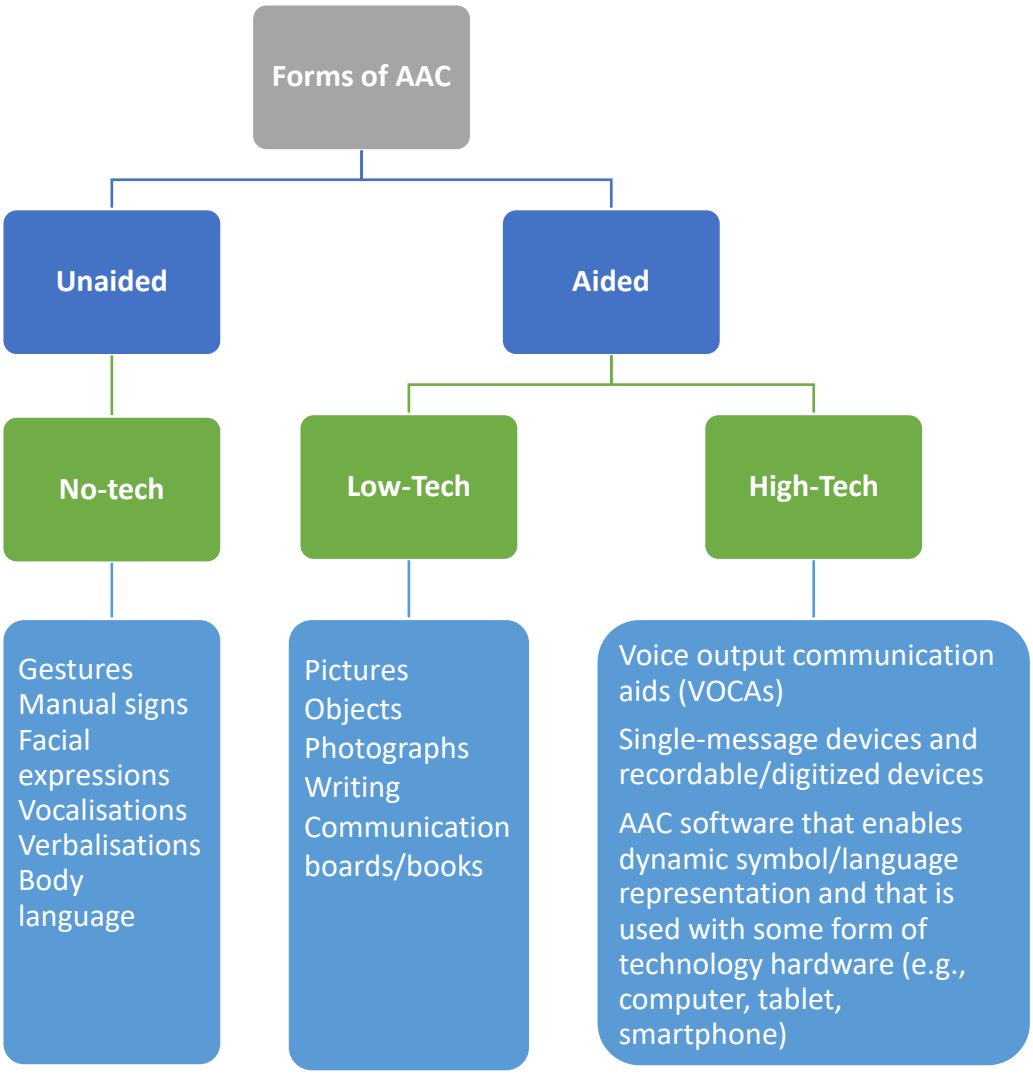

Figure 1.1 Forms of AAC (from American Speech-Language-Hearing Association, 2019b)

1.2.1 AAC and the child with ASC

Manual sign communication

The first studies which described the use of AAC to support the communication skills of children with ASC date back to the 1970s (Schlosser and Wendt, 2008b). In these studies children with ASC were taught to use manual signs as a mode of AAC e.g., Carr et al. (1978). Manual signing is seen as advantageous for children with ASC who have poor speech imitation as imitation of fine or gross motor movements might be possible (Schlosser and Wendt, 2008b). Wendt (2009) states

that the use of manual signs is particularly advantageous as an AAC system as it is unaided and therefore no external equipment is required, thus manual signs are highly portable. The literature is confusing as Ganz (2015), however, states that the use of manual signs for children with ASC demonstrates weak or questionable effects due to the small number of signs taught to a few participants. Wendt's (2009) review of the acquisition of manual signs for children with ASC concludes that manual signs can be very effective communication options for children with ASC. Even so, manual signing has its drawbacks, as it places demands on communication partners to understand this system of communication, which is particularly difficult for more abstract signs (Wendt, 2009). Furthermore, it is recognised that children with ASC may also have difficulties with the imitation skills required for successful sign production due to difficulties with motor planning, control and execution (Yoder and Layton, 1988; Seal and Bonvillian, 1997).

The popularity of manual signs as an AAC system for children with ASC declined in the 80s and 90s with a shift in favour of visual graphic systems used either alone as a low-tech AAC system e.g., pictures on a board, or in combination with a computer as a high-tech AAC system (Thunberg, 2011). The preference for aided AAC for children with ASC, may, in part be due to available research which has indicated that aided AAC is more efficacious than manual signing for providing a functional communication system for children with ASC (Ganz, 2014).

1.2.2 Low-tech AAC systems

Low-tech AAC systems which made use of visual graphic symbols began to be utilised in the 1980s as it was felt that these were a good match for the relatively strong visuospatial strengths of children with ASC (Wendt, 2009). Furthermore, the use of visual-graphic symbols placed less demand on motor skills than that required for manual signing systems (Howlin, 2006). Despite this, studies such as, Konstantareas (1987) revealed that spontaneous use of the visual graphic symbols was rare, and that generalisation of their use to other people and locations was

poor. One particular AAC system which was designed to address these difficulties is the Picture Exchange Communication System (PECS) developed by Bondy and Frost (1994). In their description of PECS, Bondy and Frost (1994) state that PECS is a communication training system based on the principles of applied behaviour analysis (ABA) thereby utilising prompting and reinforcement as strategies to teach the child spontaneous and functional communication.

PECS is a systematic approach designed to teach children with ASC to request and comment using visual-graphic symbols which are kept in a PECS book (Thunberg, 2011). It has been suggested that PECS is arguably the most widely used form of AAC with individuals with ASC (Ganz et al., 2012a). In Flippin et al.'s (2010) meta-analysis of the PECS approach it was concluded that the use of this approach with children with ASC resulted in small to moderate effects. In a later meta-analysis by Ganz et al. (2012a) it was suggested that PECS is a promising method with moderate effects on functional communication. The authors stated that the strongest effects were exhibited in children who were preschoolers. The PECS approach does present with some disadvantages. Firstly, it does not provide the child with the voice output which is available in high tech AAC systems (Schlosser and Blischak, 2001), and secondly, the PECS book can be cumbersome to carry (Lorah, 2016). This low-tech mode of communication also requires greater motor skills than that required for a high-tech AAC system (Flores et al., 2012). Recent technological advancements have provided solutions to some of these disadvantages as these can be addressed with the use of mobile technology e.g., an iPad which can function as an AAC system when an AAC application (app) is uploaded. Recent studies which have compared the use of PECS books with iPads as AAC modes either found no difference between the systems e.g., Flores et al. (2012), or that acquisition of communication skills was faster with the VOCA e.g., (Lorah, 2016). There is some evidence that children with ASC can equally be taught to use PECS or an iPad as a VOCA from the outset of intervention (Agius and Vance, 2016).

1.2.3 High-tech AAC systems

High-tech AAC includes VOCAs which are portable electronic devices with voice output in the form of digitised or synthesised speech (American Speech-Language-Hearing Association, 2019a). The speech is typically activated when a symbol is touched or pressed and it has been suggested that the voice output could potentially facilitate natural communication interactions and socialisation (Mirenda, 2003). High-tech AAC modalities may be PC based or include the use of mobile technologies which can be used as AAC devices once an AAC application (app) is loaded onto the device.

Light and McNaughton (2012a) state that the use of mobile technology as a mode of AAC is a significant trend as it has resulted in greater uptake of AAC devices. In recent years, mobile technologies which include iPads have been extensively utilised as a mode of AAC with children with ASC. This is because the use of such technologies presents with many advantages: they are relatively inexpensive, easily available, and families place high social value on such technologies (Light and McNaughton, 2012a; Light and McNaughton, 2013). iPad technologies are also easier to use as the technical operations used for AAC apps resemble those used in other iPad apps which communication partners might already be familiar with (McNaughton and Light, 2013). Gilroy et al. (2017) state that given these advantages it is understandable that mobile technologies are being pursued as a replacement for low-tech AAC modalities such as PECS.

A number of studies have been carried out with children with ASC in which iPads were utilised as the mode of AAC e.g., Flores et al. (2012), van der Meer et al. (2012), King et al. (2014), Agius and Vance (2016), Lorah et al. (2016) and McLay et al. (2017). Furthermore, studies which utilised mainstream tablet technologies as the AAC mode with children with ASC and other developmental disabilities have been included in reviews e.g., Kagohara et al. (2013), Stephenson and Limbrick (2015), and Hong et al. (2017). In Kagohara et al.'s (2013) systematic review of the literature on tablet technology utilised with children with ASC it was concluded

that such devices could be used as a mode of AAC to target communication skills although most included studies only taught the skill of requesting.

Stephenson and Limbrick's (2015) meta-analysis contributed further to the literature base by providing aggregate effect sizes which were used to calculate the effectiveness of eight studies which utilised mobile devices as VOCAs to teach communication skills to individuals with developmental disabilities. The majority of the participants had a diagnosis of ASC and were aged between 4 and 23 years. The main focus of the included studies was on teaching requesting skills although one study focussed on naming as a communicative skill. Using the percentage of non-overlapping data (PND; Scruggs et al., 1987), a total of eight studies which utilised mobile devices to support communication skills were individually rated as effective to very effective. It is notable, however, that of the 25 participants that took part in these studies, three participants did not learn to use the VOCAs and nine could only use the device when one visual-graphic symbol was presented on the display.

A more recent meta-analysis of single case experimental design studies (SCEDs) in which mobile devices were used to support communication skills was published by Hong et al. (2017). This study built on Stephenson and Limbrick's (2015) meta-analysis in two ways. Firstly, the design standards described by the What Works Clearing House for SCEDs (Kratchowill et al., 2010) were utilised in the inclusion criteria thus ensuring that basic design quality was met for the included studies. The 14 studies which met these standards included participants diagnosed with ASC aged 3 to 44 years. Secondly, the authors utilised the Tau nonoverlap effect size to calculate effect size for the included SCEDs which they reasoned is one of the more sensitive measures of the nonoverlap indices available. A large effects size was calculated when all 14 studies which utilised mobile technology as an AAC intervention were grouped. Their findings were similar to those of Kagohara et al. (2013) and Stephenson and Limbrick (2015) indicating that mobile technology is a viable modality for teaching communication skills to individuals with ASC.

Ultimately the goal of using new technologies as a mode of AAC is to improve communication outcomes for children with ASC. In Light and McNaughton's (2012a) paper, it is stated that although the potential positive effects of AAC interventions for children have been established through research, the challenge to improve communication outcomes for children who require AAC remains. Although mainstream tablet technologies including iPads are readily available, it is suggested that learning to use the current range of AAC devices still comes at a cost as they were not designed with the learning needs of children in mind (Light and Drager, 2002; Light and McNaughton, 2012a). It has been proposed that through the redesign of AAC technologies/apps it could be possible to minimise learning demands for these children (Light and McNaughton, 2012a; Light et al., 2019a). Specifically, it has been suggested that the language representation method which includes the way vocabulary is laid out and is organised on the display of the VOCA could impact outcomes in relation to learning to use the AAC system (Olin et al., 2010; Light and McNaughton, 2012a; Light et al., 2019a). This is not surprising when it is considered that in using an AAC system for communicative purposes there is a reliance on making vocabulary visual. In this situation, therefore, the child is expected to use visual-spatial processing skills to perceive, identify, locate, recall and then use the vocabulary in order to communicate (Wilkinson and Jagaroo, 2004). This therefore has relevance to the way that the vocabulary is represented e.g., photos or symbols, and the system of organisation of this vocabulary (Wilkinson and Jagaroo, 2004). Of particular interest to this thesis is the way that the vocabulary is organised on the display as it has been suggested that this is likely to impact on communication outcomes (Light and McNaughton, 2012a).

1.3 VOCA display layouts

Drager et al. (2010) refer to five approaches to the organisation of vocabulary within aided AAC systems. When a taxonomic organisation is utilised vocabulary is organised according to semantic categories e.g., people, food, and places (Beukelman and Mirenda, 2013). Vocabulary may also be organised according to

the parts of speech and this is referred to as semantic/grammatical organisation of vocabulary. Utilising this approach, vocabulary is organised according to spoken word and print orientation (American Speech-Language-Hearing Association, 2019b). According to Drager et al. (2010) when this approach is utilised, colour coding to match the category, or part of speech to which they belong may be included.

Another approach to vocabulary organisation is an alphabetical one and this is similar to the way vocabulary is organised in a dictionary. A further approach to vocabulary organisation is based on frequency of use. In such instances, the words, concepts, phrases or sentences which are used most frequently are positioned in areas of the AAC system which are the easiest to access (American Speech-Language-Hearing Association, 2019b).

A schematic approach to the organisation of vocabulary involves taking a contextual or activity based approach to vocabulary organisation (Drager et al., 2003). In such an approach, vocabulary relevant to people, places, actions, objects, feelings, and adjectives are all represented on one page, as is appropriate to an environment, activity or context. While this kind of vocabulary organisation is often utilised in grids, its principles also underlie another kind of approach to vocabulary organisation: that of visual scene displays (VSDs; Beukelman and Mirenda, 2013).

Historically, most displays on a VOCA have been designed as a grid layout in which visual-graphic symbols such as photos or pictures which represent vocabulary are displayed in rows and columns with minimal contextual support (Figure 1.2; Drager et al., 2003; Drager et al., 2004; Olin et al., 2010). In a grid display, vocabulary is decontextualized to support the child to create novel utterances regardless of the communication context which the child is in, thus the word *BOOK* can be used equally in a home or a school setting (Barton-Hulsey et al., 2017). All the studies included in the reviews of the use of mobile devices as

VOCAs, described previously, utilised AAC apps in a grid layout for vocabulary organisation. There is, however, an emerging body of research which has begun to investigate the utility of visual scene displays as another option for the organisation of vocabulary e.g., Drager et al. (2003) and more recently for children with ASC, Gevarter et al. (2014; 2017; 2018).

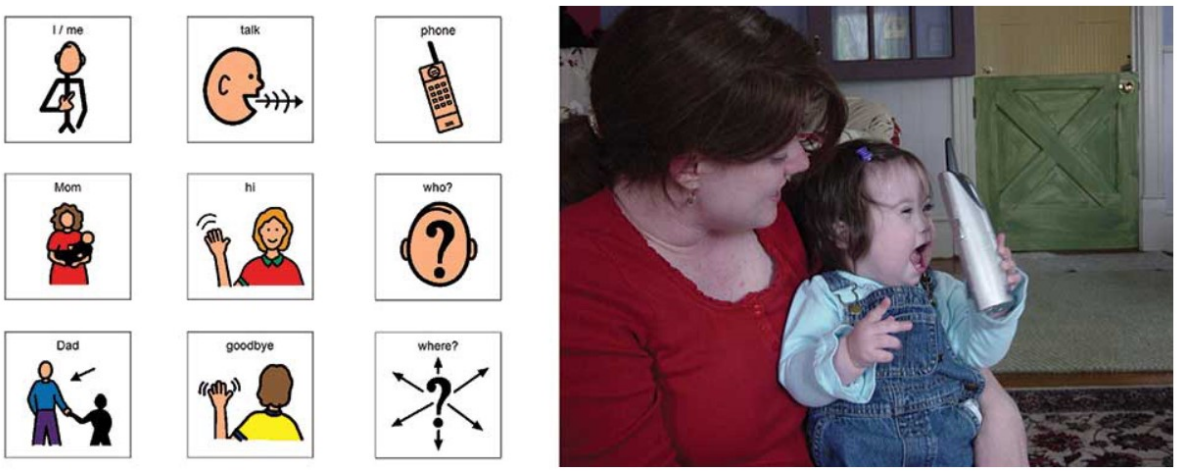

Figure 1.2 Example of a grid display (left) and a visual scene display (right) for playing telephone (from Light and McNaughton, 2012a)

In 1991, Lindsay and Light stated that as adults were the designers of AAC systems it was possible that these designs were not appropriate for children who required AAC systems. This was because adults' conceptual models of the world were unlikely to make sense to children. The authors proposed that the net result could be an increase in costs in terms of time and effort required to learn to use the AAC system thus rendering the system less effective. Specifically, in 2003, Drager and colleagues proposed that the use of vocabulary organised in a grid layout was likely to place significant learning demands on children. Furthermore, Shane and Weiss-Kapp (2007) suggested that learning to use an AAC system with vocabulary organised in a grid layout may lead to considerable linguistic, sensory perceptual, motor and cognitive demands.

Use of an AAC system involves the skills of visual attention, visual perception, and visual processing (Gillespie-Smith and Fletcher-Watson, 2014). Although not well researched within the field of AAC, it has been suggested that there are likely to be important differences in the way grids and VSDs are processed (Wilkinson and Jagaroo, 2004; Wilkinson et al., 2012). According to Light and McNaughton (2012a) in order to successfully use visual-graphic symbols organised in a grid layout several steps are required. Firstly, the child must process each visual-graphic symbol separately, then it is necessary to retrieve the concepts which the visual-graphic symbols represent. Following retrieval, working memory is utilised to hold the concepts before integrating them to understand the communicative context which is being represented. Finally the visual-graphic symbol is used to communicate. In order to reduce these collective demands, Drager et al. (2003) proposed that young children could perform better with AAC technologies in which the language concepts are presented in context as may be seen in the VSD in Figure 1.2. This is because working memory demands could be reduced as visual-graphic symbols are chunked together in the scene (Light and McNaughton, 2012a). Wilkinson and Jagaroo (2004) state that in processing a VSD, attention to each object in the scene is not necessary, as it is in a grid, as processing the gist of the scene is sufficient.

Drager et al. (2003) also proposed that the use of a VSD as a means of organising vocabulary on an AAC system was a more natural approach to the teaching of communication: one which is more reflective of how typically developing children learn language concepts. This proposal was based on the work of Bruner (1983) and Nelson (1986) who noted that typically developing children learned early language concepts in environments which were rich in context so a child might learn the word 'DOG' because he hears the verbal label in a natural situation such as when seeing a dog in a park. It is the intent of VSDs to replicate this language learning through photos with embedded language concepts which are a visual portrayal of the real-life experiences by children (Wilkinson et al., 2012). The use of events and contexts which the child is familiar with are therefore utilised to tap

into the learning mechanisms which are thought to underlie language learning (Light et al., 2004; Light and McNaughton, 2012a; Barton-Hulsey et al., 2017).

VSDs, therefore, are representations of events, activities, people and actions against the backgrounds within which they usually exist involving the use of a visual representation e.g., a photo or picture of a scene which is highly personalised (Blackstone et al., 2005; Wilkinson et al., 2012). The scene is programmed with voice output hotspots which are embedded within the scene (Drager et al., 2003; Drager et al., 2004; Light et al., 2004; Blackstone et al., 2005; Gevarter et al., 2018). When tapped, each hotspot, which represents language concepts, emits words and phrases (Wilkinson et al., 2012). Blackstone et al. (2005) state that the use of a VSD can provide a specific communication environment within which individuals can talk about the topic represented in the scene thus engaging in shared conversations. In a VSD, page links between pages in a VSD are organised schematically, thus these are according to items grouped by activity or event (Gevarter et al., 2014).

Several advantages to the use of VSDs have been hypothesised including a possible reduction of working memory demands (Drager et al., 2003). Furthermore, Wilkinson et al. (2012) proposed that the VSD supports the ability to rapidly visually process various concepts which are embedded in the scene because it is similar to how humans visually process naturalistic scenes. The authors state that while VSDs may appear to have numerous elements which in theory adds to demands on the user's visual perception and processing, they argue that this load could be offset by the use of naturalistic scenes which provides visual advantages. It is also suggested that VSDs are advantageous as the symbols derive meaning in two ways: firstly from the graphic representation itself e.g., a glass, and secondly, from the relation of that graphic representation to the rest of the scene e.g., drink on a table with other breakfast food indicates juice (Drager et al., 2003). It is has been suggested that VSDs are most suitable

for young children who are in the early stages of communicative development (Blackstone et al., 2005).

Although many papers have been written on the potential benefits of the use of VSDs, not all researchers are in agreement with this. Drager et al. (2003) note that the use of VSDs may be challenging for children with visual-spatial difficulties as, for the user, they may be visually more complex than single icons presented in a grid layout. The authors note that for children with motor difficulties the VSD may present a challenge as the concepts implied by the scene are no longer discrete from one another. Some research has questioned whether the proposed benefits of VSDs are useful for children with developmental disabilities (Barton-Hulsey et al., 2017). This is because research from the area of developmental psychology has indicated that children under the age of 3 years do not readily understand that a scale model of a room or a photograph is a symbolic representation of a life size room (DeLoache and Brown, 1983; DeLoache, 1991; DeLoache, 2000).

von Tetzchner and Staskleiv (2016a) question whether a VSD is, in fact, a communication aid preferring to classify a VSD as a visual support which may be used to support the topic of conversation. Furthermore, von Tetzchner and Staskleiv (2016a) refer to Light and McNaughton's (2012a) claims that VSDs replicate events which have been experienced by children to support access to language concepts. In relation to this, von Tetzchner and Staskleiv (2016a) state than any photograph is capable of achieving this. von Tetzchner (2015) has questioned what is actually being learned by the child when a VSD is used to organise vocabulary to support expressive communication because distinct visual-graphic symbols are omitted. Von Tetzchner (2015) also states that the use of language concepts in scenes would make it extremely difficult to free the image from other meanings that are associated with the scene. This is important in order to generalise vocabulary from a scene to other contexts which Wilkinson and Jagaroo (2004) have stated is one of the advantages of a grid display. Olin et al.

(2010) and Reichle and Drager (2010) have, in fact, specifically questioned how symbols embedded in scenes could generalise to different contexts e.g., the child may have learned the word *BED* in a VSD of his own bedroom, would he understand the same concept in relation to naptime during his time at his day care setting? Furthermore, Olin et al. (2010) state that the use of VSDs may not be advantageous for children who are in the process of developing morphology. This has also, however, been acknowledged by Light and McNaughton (2012a) who state that VSDs may be less effective at supporting complex syntactical and morphological development. Other researchers have questioned how non-iconic symbols which represent vocabulary other than nouns might be used in the context of a VSD (Reichle and Drager, 2010; Barton-Hulsey et al., 2017). Consequently, von Tetzchner (2015) questions how the child's semantic development may be impacted. There are further questions about the long-term consequences of learning language through VSDs and it has been suggested that there could be a negative impact on utterance variation (von Tezchner and Stadskleiv, 2016). Barton Hulsey et al. (2017) note that as hotspots are programmed according to the communicative context, consistency of location of vocabulary may differ from one VSD to another leading to the reorganisation of symbols in each scene which is typical of VSDs. The authors have questioned whether locating vocabulary presented in VSDs may therefore actually be more demanding for the child.

1.4 Evidence base for VSD versus grid displays

In light of the discussion above, it appears that the use of VSDs has generated some controversy. In order to make decisions about whether VSDs could positively impact communication outcomes for children with ASC, it is important to consider the evidence base for their use. The initial studies which compared grid displays with VSDs were primarily carried out with young typically developing children in play tasks e.g., Drager et al. (2003); Drager et al. (2004); Light et al. (2004). In all of these studies, the participants who were randomly assigned to groups were asked to locate vocabulary on displays with different layouts. In the earliest study,

Drager et al. (2003) compared three displays; a taxonomic grid, a schematic grid and a VSD. In this study, the authors reported that the 30 participants who were aged between 2;06 and 2;11yrs located the vocabulary best in the VSD condition. Drager et al. (2004) also replicated their earlier study with 30 slightly older children aged 3;0-3;11yrs. The results of this study were similar to the previous one with greater accuracy of location of vocabulary in the VSD. In Light et al.'s (2004) study which also included 30 participants, two of the four displays compared were a taxonomic grid and a VSD. In this study which included participants aged 4 and 5 years old, no difference was found in accuracy of the location of vocabulary items. There are two important implications of these three studies when relating the results to children with ASC: firstly, the participation of typically developing children in all three studies may limit generalisation to children with ASC. Secondly, the studies focussed on locating vocabulary rather than a true communicative task involving a functional communicative response. A task such as requesting may better approximate the skills that are required of an AAC user when using a VOCA.

One study in which a VSD was compared with a grid display that included two groups of participants who were either typically developing or had communication disorders is described by Wood Jackson et al. (2011). In this study, 39 children aged between 2;06 and 5;06 years were exposed to both display layouts in a shared book reading activity. As a group, the results indicated that the participants were more likely to explore the grid display. There were also more voice activations of the grid display when the adult was reading the story. When asked closed questions, there was no difference between accuracy of responses when the total group of participants was taken into consideration. When the responses of the children who were minimally verbal were considered separately, there appeared to be a slight advantage for the VSD condition although this did not reach significance. When asked open ended questions, again there was no statistical difference for the combined group although there were increased activations of the grid display. Children who were minimally verbal activated the

grid display more frequently during open ended questions. Additionally, it was noted that children were more likely to make silent hits during the VSD condition. Silent hits were defined as attempts to activate the VOCA but voice output was not activated. The authors explained the number of silent hits in several ways. Firstly, they identified that the vocabulary items in the VSD condition did not have visual boundaries. Secondly, they note that some hotspots were smaller, in keeping with the proportions of objects represented in the scene and that this may have affected accuracy. Drager et al. (2003) had also hypothesised that the use of VSDs may place a greater demand on motoric skills particularly for children with disabilities as the vocabulary is embedded within the spatial context of the scene in contrast to grid displays in which vocabulary is isolated in discrete large squares. The study results therefore, raise further issues for consideration as firstly, the results did not demonstrate a clear advantage for one display over another and secondly, while the participants were minimally verbal, these were not children with ASC.

Evaluating the evidence for VSDs and grid displays for children with ASC is particularly important as it is possible that the results of the studies presented above may not be generalizable to these children. In Gillespie-Smith and Fletcher-Watson's (2014) review of eye-tracking research carried out with children with ASC it is suggested that presentation of stimuli in a grid array could be beneficial because children with ASC fixate on targets quickly utilising fewer eye movements to do this when searching for targets. Conversely, Wilkinson et al. (2012), state that given that children with ASC have demonstrated superior skills in a range of visual search tasks it is possible the use of VSDs might be particularly suitable for children with ASC. There is, however, evidence to suggest that children with ASC have difficulties identifying items from a complex array of stimuli (Reichle and Drager, 2010). It has also been suggested that children with ASC are more likely to over focus on specific elements of stimuli when compared to other children (Liss et al., 2006). Wilkinson et al. (2012) therefore also suggest that it is possible that VSDs would present a difficulty for children with ASC. Reichle and Drager

(2010) have also speculated that the generalisation difficulties which children with ASC generally present with may extend to their learning of vocabulary in VSDs as this is context bound. They suggest that when vocabulary is context bound it is much more difficult for it to be extended to other scenes e.g., a scene with a child's dog may not generalise to other dogs which the child would like to communicate about. Reichle and Drager (2010) also refer to the possibility that representational skills could be delayed in children with ASC thus the possibility of any representational gains from using VSDs could be limited.

Ganz et al. (2015) described a study in which use of a VSD was compared to exchange based communication (EBC) with two preschool children with ASC who were minimally verbal. EBC refers to communication which involves removing a visual-graphic symbol from a communication board and handing it to a communication partner but does not strictly follow the PECS protocol (Sigafoos et al., 2007). The VSD condition was an AAC app which was installed on an iPad and therefore provided voice output when the hotspots were activated. The study measured the children's spontaneous commenting and responding to questions during a story book activity. No intervention was provided and the study was therefore a comparison of the two AAC systems. One participant did not use either form of AAC during the course of the study. The second participant commented and responded to questions more frequently in the VSD condition. As voice output was only available in the VSD condition it is possible that this might have provided an advantage over the EBC condition thus it is difficult to attribute the results to the display. In order to make a true comparison between the two displays, it would therefore be important for both conditions to either produce voice output or for both conditions not to emit voice output.

Three studies by Gevarter et al. (2014; 2017; 2018) included children with ASC and compared a grid display with a VSD. In all of these studies, an iPad was used thus voice output was a feature in all display conditions. In the first study, three children with ASC aged 3 years old were taught to request preferred items using a

VSD, a grid display, and a hybrid display. Hybrid displays consist of a combined grid and VSD elements e.g., some symbol vocabulary organised in a row at the bottom of the VSD (Gevarter et al., 2017). Two participants achieved criterion faster in the VSD condition, the third participant reached criterion in the grid display first. The authors concluded that the study findings suggest that display elements such as layout might influence acquisition of requesting skills. There were, however, some limitations to this study. Firstly, different AAC apps were utilised for each of the display conditions. It is then difficult to attribute the results purely to the display layout as each app may have had other features which could have influenced learning to use the VOCA. Furthermore, the display layouts were similar as only one reinforcer was presented on the display at one time thus effectively reducing the VSD to a grid display. Finally, a photograph of the reinforcer was used for the VSD condition, while a PCS symbol was used for the same reinforcer for the grid display condition which may further have influenced the results due to the difference in iconicity of the symbols used.

In the second study by Gevarter and colleagues (2017) requesting of preferred items was taught using a VSD and a grid display to five children aged between 3 and 8 years with a diagnosis of ASC. In this study, the participants were taught to request from a field of four items on the screen. This meant that there were four programmed hotspots on the VSD which utilised a photo, and a 2x2 cell layout which was programmed with symbols in the grid display condition. In this study the same AAC app was used for both conditions on an iPad based AAC system. Three of the participants learned to request from the field of four fastest in the VSD layout. One participant learned to request from a field of two and was also fastest using a VSD layout. The fifth participant did not go beyond requesting with a single reinforcer on the screen. The authors suggest that the use of symbols in all the conditions apart from the VSD may have played a part in the results. This is because iconicity was not as strong in the conditions in which symbols were used. This use of photos versus symbols to represent vocabulary is important as

research has indicated that that photos are easier to learn than symbols (Mirenda and Locke, 1989).

A third study by Gevarter et al. (2018) involved teaching four children with ASC aged between 4 and 8 years to request using a grid display and a VSD (three participants) and a grid display and a hybrid (one participant). This particular study included the teaching of multistep requesting which required navigation between pages. In the grid display participants were required to navigate from the main page which had folders labelled by category including FOOD, DRINKS, and TOYS. Pressing any of these folders led to a page containing three items from within that category. For the VSD condition, three photos of different locations were displayed on the main page. This included photos of the kitchen and a playroom which when touched opened to an enlarged page of the same photo which was programmed with hotspots. For the hybrid, the first page was the same as the VSD condition. The second page was a hybrid pop-up grid with a bordered hotspot around the entire scene which then opened to a pop-up page of three symbols when touched. The results indicated that three of the participants achieved requesting in the VSD but not in the grid display. The fourth participant achieved criterion in both displays. As in the two previous studies by Gevarter et al. (2014; 2017) symbols were used in the grid display condition, and photos in the VSD. The use of photos and symbols may have had an impact on the study results. Furthermore, the authors note that errors in locating the correct VSD were prevalent with all participants. It is worth noting that from a visual processing perspective, the presentation of three VSDs on the main page was akin to a grid display.

Gevarter et al. (2014) have stated that acquisition of requesting may be affected by display layouts. They further suggest that for some children a VSD may have potential advantages e.g., more rapid acquisition of requesting skills. The leads to the possibility that some children with ASC may benefit more from one display over another. Wilkinson et al. (2012) state that it is likely that the processing of

VSDs involves different visual processing networks than that required for grid display thus the processing demands are likely to be different for each type of display. This then brings about the question of how a clinician might make the decision to represent vocabulary on a display in a particular way for an individual child with ASC. In general, it is recommended that such decisions are based on a thorough assessment process which considers several variables (Schlosser and Sigafoos, 2006; Ganz, 2014).

1.5 Assessment for AAC systems and interventions

Generally it is recommended that assessments to determine AAC systems and interventions for children with ASC who are minimally verbal should include collaboration between different professionals thus ensuring that the assessment process is thorough (Ganz, 2014). Beukelman and Mirenda (2013) suggest that a team of professionals is almost always necessary to successfully assess and implement AAC systems to ensure that all areas are covered. This is because different team members bring an array of knowledge in relation to AAC technologies, interventions, and of course the individual being assessed (Dietz et al., 2012). According to Ganz (2014), professional team members for children with ASC typically include the speech and language therapist (SLT), the school psychologist, and educational staff.

The SLT plays a central role in the assessment of children for AAC systems, often taking the lead within AAC teams (Dietz et al., 2012; American Speech Hearing Association, 2019b). It is clear, however, that the role of the SLT extends beyond the selection of AAC systems and also includes making decisions to ensure their successful implementation (Beukelman and Mirenda, 2013). The SLT therefore develops an implementation plan which includes decisions about goals and objectives to support the implementation of AAC systems (Ganz, 2014; American Speech Hearing Association, 2019b). When considered necessary, a SLT will make referrals to other professionals to support the assessment process (American Speech Hearing Association, 2019b). Batorowicz and Shepherd (2011) note that in

Canada in situations when the individual has no motor difficulties, the primary clinician involved in carrying out the AAC assessment is the SLT. Occupational therapists (OT) are only typically involved in AAC assessments when motor difficulties are present.

According to Dietz et al. (2012), one model that is often considered to be best practice for AAC assessment is Beukelman & Mirenda's Participation Model (2013; Figure 1.3). The model provides a systematic process for assessments and interventions for the present and for the future which is designed to support participation using AAC systems and interventions (Mirenda, 2009; Beukelman and Mirenda, 2013). In this model, two types of participation barriers are identified which could impact the child's participation: those related to opportunity and others related to access (Beukelman and Mirenda, 2013). This model is useful as it goes beyond the assessment of the child, also capturing some of the barriers which could be evident in the child's environment and social system (Light and McNaughton, 2015). This is important because it is reported that AAC outcomes within this group of children are variable and are likely to be impacted by factors such as the ability of communication partners therefore going beyond the heterogeneity of the children themselves (Sievers et al., 2018).

On the left of the model opportunity barriers are referred to. These barriers result from people in the child's environment and may prevent successful AAC device use (Torrison et al., 2007). Opportunity barriers are divided into five groups (Beukelman and Mirenda, 2013). The first type are policy barriers which refer to legislative decisions that could negatively impact on the child who is minimally verbal e.g., a policy might exist which states that a child cannot bring his AAC device to school. A further type of opportunity barrier is referred to as a practice barrier and refers to long standing practices which are utilised which might negatively impact the child who needs to use AAC but are not policy. Knowledge barriers refer to lack of knowledge about AAC interventions, technologies and the teaching strategies required to successfully implement AAC interventions. When

facilitators who work with the child have the knowledge but have difficulty with the implementation of an AAC system or strategy, these are then referred to as skills barriers. Light and McNaughton (2015) note the importance of communication partners having the knowledge and skills in the area of AAC given that they are likely to spend large amounts of time with the child with AAC. The final type of barrier refers to attitude, and may refer to restricted of negative barriers towards the use of AAC systems and interventions and reduced expectations for children who are minimally verbal.

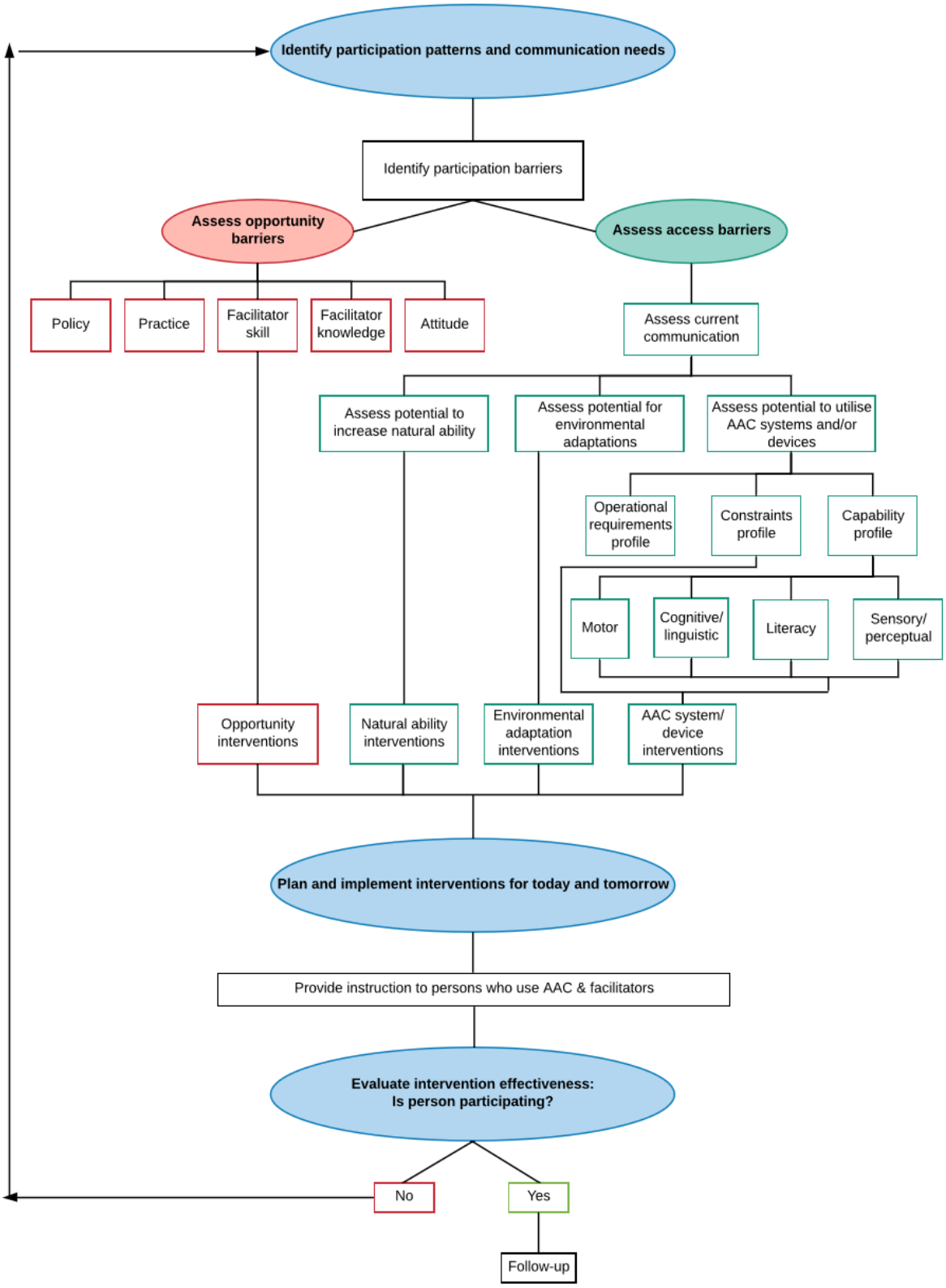

Figure 1.3 Participation model (Beukelman and Mirenda, 2013)

Beukelman and Mirenda (2013) state that there are other access barriers which should also be assessed as part of the Participation Model. Access barriers refer to the capabilities, attitudes and resource limitations of the child who is minimally verbal. The child's current communication skills are therefore assessed and this also includes the potential to use and/or increase speech. An assessment of the environment is carried out to ensure that through environmental adaptations the child is supported to use the AAC system. In order to specifically assess the child's potential to use an AAC system, three areas are assessed: operational requirements, constraints, and capability. Operational requirements refers to the requirements of various AAC systems e.g., the decision to use a VSD versus a grid display on a high tech AAC device might be considered. This is taken into consideration because it is important that the device matches the child's abilities. The assessment of constraints allows for issues to be taken into consideration which are not directly related to the child and the technology, for example, the preferences of the family, and funding issues. The final area refers to the assessment of the child's specific capabilities and includes the child's motor, cognitive and linguistic, literacy and sensory perceptual skills including hearing and vision.

Recent research has begun to focus on how SLTs set about making decisions and recommendations within the AAC process, for example, Dietz et al. (2012); Lund et al. (2017) and Murray et al. (2019). This is because the Participation Model (Beukelman and Mirenda, 2013) is a theoretical model which provides little information on how it should be applied in real life clinical contexts (Lund et al., 2017). While the Participation Model provides a framework covering the main areas that should be assessed, there is limited guidance on how it can be used with specific populations (Lund et al., 2017). It has been stated, that there are few guidelines in general which support the AAC assessment process for children with ASC (Ganz, 2014). Recent research by Lund et al. (2017) which explored the decision-making process for AAC systems in relation to two case studies: a child with ASC and a child with cerebral palsy, has provided some preliminary evidence

that different aspects of the Participation Model may need a greater emphasis according to the child's diagnosis. While some aspects of the assessment appeared to be common to both diagnoses there were specific differences in what was assessed and in the method of assessment e.g., there was greater discussion about how the child with ASC communicated than there was for the child with CP. This therefore provided some preliminary evidence that AAC assessments need to be tailored to specific individuals while keeping in mind the diagnosis which may require emphasis on certain areas of assessment (Dietz et al., 2012).

More recently, Murray et al. (2019) and Lynch et al. (2019) specifically explored AAC clinical decision making in the UK through a series of focus groups involving professionals and families of AAC users. The results of their research indicated that the assessment process in the UK appears to be a two-stage process. Initially the assessment process was focussed on child factors, communication aid features, and access to the device. Similar to Lund et al.'s (2017) results the conclusions in the Murray et al. (2019) and Lynch et al. (2019) papers also demonstrated a focus on the individual child in the beginning stages of AAC assessment. Murray et al. (2019) and Lynch et al.'s (2019) papers, however, extend the research further as their findings indicated that once a decision is made about the child, access, and communication aid features, external factors to the child are then considered. These may include cultural and contextual influencers such as the ways of working and available resources. It is possible that this could also be extended to children with a diagnosis of ASC.

In considering the child at the start of assessment, this can be related to the Participation Model's capability profile which includes assessment of the child's motor, cognitive and linguistic, literacy and sensory perceptual skills. Ganz (2014) who specifically discussed the assessment of children with ASC for AAC systems similarly refers to the need to assess motor, cognitive, literacy and communication skills.

Returning back to the latest release of the DSM-5, the reference to sensory reactivity as a core characteristic of ASC is noted. Prevalence estimates indicate that sensory processing difficulties are evident in 40% to over 90% of children diagnosed with ASC (Ben-Sasson et al., 2009; Baranek et al., 2014). The presence of sensory processing differences may be important, firstly because it could impact on the clinician's ability to fully understand the child's capabilities and this in turn could have implications for the AAC systems recommended. Secondly, the presence of sensory processing difficulties, may impact learning to use AAC systems as is it has been stated that sensory processing difficulties may significantly impair a child's ability to participate because successful processing of sensory information is the basis for higher order learning (O'Donnell et al., 2012; Schooling et al., 2012).

Watson et al. (2011) have stated that it is sensory processing patterns which lay down developmental functioning for social, communication and language development. The potential impact of sensory processing difficulties for children with ASC is important because the process of assessment of AAC includes going beyond identifying the AAC systems that appear to be most appropriate for the individual child but also includes considering how best to provide interventions to learn to use the recommended system (Beukelman and Mirenda, 2013). In view of this, a consideration of sensory processing patterns within the AAC assessment and intervention process could lead to improved outcomes in the longer term.

1.6 Sensory processing difficulties and ASC

The human brain has been described as a sensory processing machine because over 80% of the nervous system is involved in the processing and organising of sensory input (Ayres, 1985). Individuals, particularly children with ASC, differ in the way they process information through the senses (Ben-Sasson et al., 2009). In general, information is processed through the auditory, tactile, visual, olfactory and gustatory senses. Two further senses which are also referred to in the literature in relation to sensory processing are vestibular and proprioception.

The vestibular system which is located in the inner ear concerns movement e.g., walking, standing, crawling etc. and provides information about how the body is interacting with the world (Dunn et al., 2002). This system is also concerned with gravity thus informing the individual of his/her position in relation to gravity to maintain equilibrium (Myles et al., 2000). It has been stated that it is considered to be the sensory system which has the most influence on other systems and on ability to function in everyday life because it unifies information received through the other sensory systems (Cheatum and Hammond, 2000).

The proprioceptive system is located in the muscles and joints and provides information about the individual's body (Dunn et al., 2002). More specifically it includes the provision of information about the location and movement of specific body parts (Myles et al., 2000).

Sensory processing refers to the way that information which comes through the senses is managed in the brain in order to enable purposeful adaptive responses to the environment and participate in meaningful life activities (Johnson-Ecker and Parham, 2000). The theory of sensory processing suggests that in order for optimal functioning to occur in daily living environments, there must be efficient reception and integration of incoming sensory information (Baker et al., 2008). When the processing of sensory information is effective, learning and co-ordinated movements are possible (Bundy et al., 2002), thus sensory processing plays a fundamental role in functional performance in a range of activities (Tomchek and Dunn, 2007). Given the published research on the importance of sensory processing for everyday life activities, it is interesting to consider how this might or might not impact on learning to use an AAC device for communicative purposes as there is a lack of consideration of these skills in the AAC literature.

According to Baker et al. (2008) difficulties in sensory processing in children diagnosed with ASC are widely documented in the literature. In one study, for example, the prevalence of such difficulties in 281 children with ASC was 95%

(Tomchek and Dunn, 2007). Difficulties in sensory processing have been reported to occur across all sensory domains (Harrison and Hare, 2004), and in the absence of a hearing or visual impairment (Baranek, 2002). Difficulties in sensory processing are therefore related to the structures and pathways of the central nervous system and not the receptors which are associated with peripheral sensory functions (Case-Smith et al., 2015).

There has been some interest in sensory subtyping because of the heterogeneity of interventions children with ASC require due to their sensory processing difficulties. Identification of subtypes of sensory processing patterns could support professionals to better tailor interventions for children with ASC (Gonthier et al., 2016; Simpson et al., 2019). In DeBoth and Reynolds' (2017) systematic review of literature relating to sensory based subtypes and children with ASC, little consensus was found on subtypes. The study also found that there are a group of children with ASC who present with typical sensory processing patterns.

One frequently utilised model of viewing sensory processing is Miller et al.'s (2007) nosology of sensory processing which is used as a taxonomy for sensory processing disorders. This nosology refers to three categories of sensory processing disorder: sensory modulation disorder, sensory-based motor disorder, and sensory discrimination (Figure 1.4).

When sensory-based motor disorders are present, poor postural or volitional movements are evident (Miller et al., 2007). Sensory discrimination disorders refer to difficulties with perceiving the similarities and differences between stimuli, thus there may be difficulties interpreting the qualities of sensory stimuli (Miller et al., 2007). Sensory modulation disorders which are defined as difficulty with formulating an appropriate response to sensory input are frequently described in children with ASC (Miller et al., 2007; Ben-Sasson et al., 2009). Tomchek and Dunn (2007) state that sensory modulation disorders arise when there is a mismatch between environmental demands and the child's internal characteristics

e.g., attention, emotional state, sensory processing. In such situations the type and intensity of the child's response is then impacted and may impede the child's ability to engage with others and to participate in activities (Miller et al., 2001; Miller et al., 2007). Differences in sensory processing in children with ASC are most often attributed to sensory modulation disorders (Ben-Sasson et al., 2009).

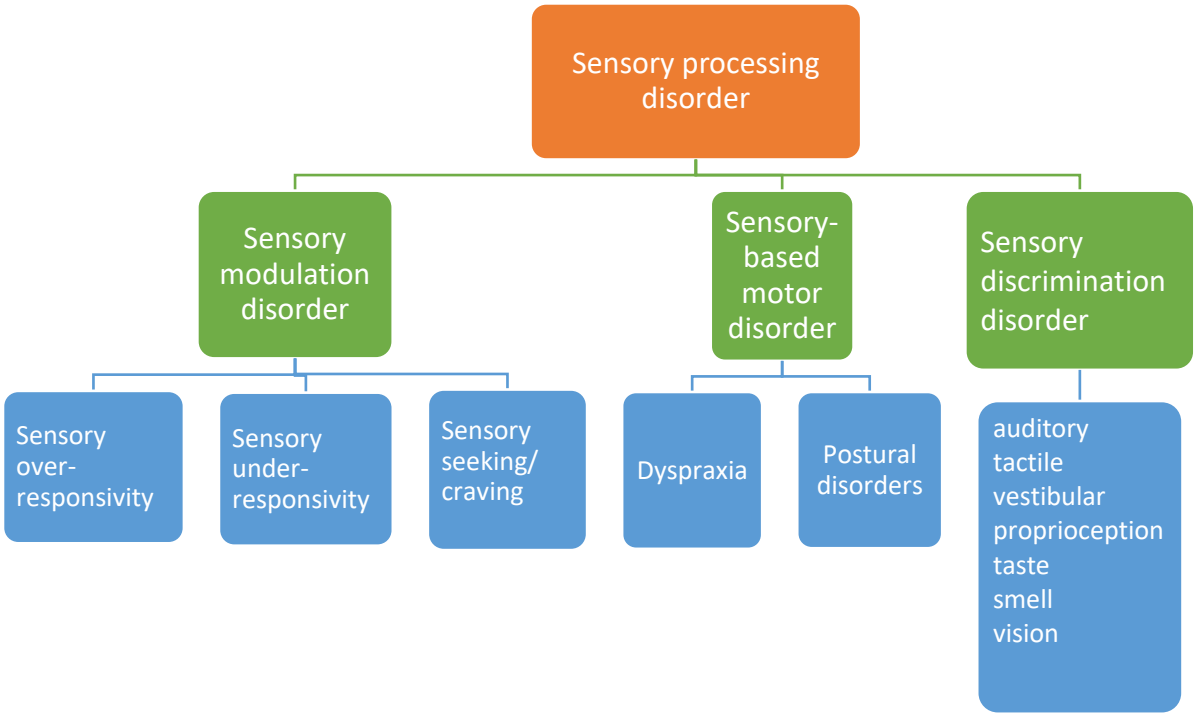

Figure 1.4 Nosology for sensory processing disorders (from Miller et al., 2007)

While sensory processing has been described using multiple models, in general, the three patterns of sensory modulation disorder are generally agreed upon and are supported by empirical findings (Boyd et al., 2010; Ismael et al., 2018). These include sensory over-responsivity (also referred to as hyper-reactivity), sensory under-responsivity (also referred to as hypo-reactivity), and sensory seeking/craving generally referred to as sensory seeking (Ashburner et al., 2008). For the remainder of this document the term sensory reactivity will be utilised to ensure consistency with terminology used in the DSM-5 (Tavassoli et al., 2016).

Hyper-reactivity, also referred to as over-responsivity, is characterised by an exaggerated, and at times negative response to sensory stimuli (Patten et al., 2013; Uljarević et al., 2016). Responses to sensory stimulation may be prolonged and their onset is often rapid (Miller et al., 2007). Avoidance of sensory stimuli may also reflect a hyper-reactive response (Watson et al., 2011). Gonthier et al. (2016) state that distress or pain may be experienced in response to certain stimuli such as noises or lights.

Children who exhibit hypo-reactivity (or under-responsivity) either fail or are slow to respond to incoming sensory stimuli (Miller et al., 2007; Ben-Sasson et al., 2009). Such children, for example, might fail to respond or exhibit a delayed response to a novel sound in the environment, or may only notice the sound when it becomes louder (Watson et al., 2011). This may also include a lack of awareness of or a delayed reaction to spoken language (Gonthier et al., 2016).

The final category of sensory modulation disorders refers to sensory seeking behaviours. Children who exhibit such behaviours seek/crave sensory stimuli demonstrate an intense fascination or seek repeated engagement with specific sensory stimuli (Williams et al., 2018). Watson et al. (2011) provide examples of sensory seeking behaviour which include staring intensely at lights or smelling of objects.

While the three response patterns of hypo-reactivity, hyper-reactivity, and sensory seeking appear to be presented as three separate constructs, Ashburner et al. (2008) and Ben-Sasson et al. (2009) clarify that these patterns are not mutually exclusive and it is possible for such patterns to co-exist in individual children (Liss et al., 2006). In such situations the child may fluctuate between extremes of hypo- and hyper-reactivity (Prizant et al., 2003). Research has also indicated that sensory modulation disorders differ in severity as well as in type (Ben-Sasson et al., 2009).

Ashburner et al. (2014) note that there is disparity in the literature in the terminology used to refer to dysfunction in the area of sensory processing. Miller et al. (2007) refer to the term *sensory processing disorders* and this term is utilised above to refer specifically to Miller et al.'s (2007) work. Parham and Mailloux (2015) prefer to use the term difficulties as they view sensory processing difficulties as part of being human rather than due to any specific pathology. The term *sensory processing difficulties* is therefore utilised in this thesis.

1.6.1 Impact of sensory processing difficulties

Differences in sensory processing are well documented in the ASC population and impact on several areas of participation (Dunn et al., 2016). Studies have reported an impact on areas such as social functioning and adaptive behaviour (Pfeiffer et al., 2005; Boyd et al., 2009). Moreover, sensory processing difficulties can influence daily living activities including eating, sleeping, and routines including bath and bedtime (Schaaf et al., 2011). Research has also indicated an association between unusual sensory processing patterns and play (Kuhaneck and Britner, 2013) and motor skills (Ayres, 1985).

According to the research, different patterns of sensory processing may be associated with differing behaviours (Simpson et al., 2019). Hypo-reactivity, for example, has been associated with poorer developmental outcomes as well as difficulties in situations which require communication (Baranek et al., 2006; Tomchek et al., 2018). Hyper-reactivity, on the other hand, has been linked to difficulties in the area of social competence (Reynolds et al., 2011).

There are studies which have specifically examined the link between sensory response patterns and the development of language and communication e.g., Liss et al. (2006), Watson et al. (2011) and Patten et al. (2013). In all of these studies, hypo-reactivity and sensory seeking patterns were more likely to be associated with poorer communication skills. Patten et al. (2013) suggest that poor orienting to communication partners may be an indication of unusual sensory processing

patterns which then interferes with participation in social and communicative interactions. Patten (2013) note that both orienting and sustaining attention to social stimuli are necessary to develop joint attention which according to Leekham et al. (2000) is frequently impaired in children with ASC. It would therefore appear that understanding the different patterns of sensory processing could be important for understanding how a child's communication skills could be affected in the long term. Furthermore, sensory processing patterns could also affect the child's progress with learning to use an AAC system. If sensory processing and different sensory processing patterns are a possible variable in learning to communicate with an AAC system, questions are raised about how the assessment and intervention process should be adjusted to reflect sensory processing difficulties.

1.6.2 Interventions for sensory processing difficulties

Due to the far-reaching impact of sensory processing difficulties, there has been a push to identify interventions which will address these difficulties (Watling and Hauer, 2015). Historically, OTs are the professionals who implement a range of interventions which address sensory processing difficulties thus supporting increased participation in a range of daily living activities (Bodison and Parham, 2018; Thompson-Hodgetts and Magill-Evans, 2018). In view of this, parents frequently seek out these interventions and have identified OTs as being the professionals whose interventions have had the greatest impact on their children with ASC (Green et al., 2006; Peacock, 2012).

Bodison and Parham (2018) stress the importance of assessment of sensory processing and integration before initiating interventions. Assessment of sensory processing is often carried out through the use of questionnaires which are administered to parents and teachers (Schauder and Bennetto, 2016). Recently, Dunn et al. (2016) noted that assessment should also include measures of participation in order to determine if and how the child's sensory processing impacts daily life.

Interventions for sensory processing difficulties are typically categorised into three groups: Ayres Sensory Integration® (ASI: Ayres, 1972; Ayres, 1979; Ayres and Robbins, 2005), sensory-based interventions, and environmental modifications (Parham and Mailloux, 2015; Bodison and Parham, 2018). Each of these will be discussed in greater detail below.

ASI is an intervention which is individualised for each child and is designed to address the underlying sensory-motor issues which have been identified in the assessment process as interfering with the child's ability to participate in activities of daily living both at home and at school (Bodison and Parham, 2018). In Watling and Hauer's (2015) systematic review of ASI and sensory-based interventions, ASI is described as an intervention which takes place in a playful context involving collaboration between the child and therapist in sensory rich activities. The authors state that these activities, designed to be meaningful, utilise specialised equipment which is devised to improve the child's ability to perform and therefore be able to meet environmental challenges. In designing this form of intervention, Ayres hypothesised that when activity challenges are presented to the child, it is possible to capitalise on the plasticity of the neural system to improve the efficiency of sensory processing (Parham and Mailloux, 2015). Bodison and Parham (2018) give the example of slow swinging which could be used to calm a child who is in an over excited state. Swinging, which provides vestibular input, is used to reduce the child's arousal levels which results in improved attention thus enabling the child to participate in a more challenging activity e.g., catching a ball while swinging, or a different kind of challenge such as navigating an obstacle course. The ASI approach is considered to be remedial because its aim is to make a change to the child's underlying ability to process and integrate sensory information (Schaaf and Miller, 2005).

The expected outcomes of the ASI approach include improvement in gross and fine motor skills, language, and academic performance (Parham and Mailloux, 2015). Evidence to support the achievement of these outcomes was not available

until recently. This was due to systematic reviews and meta-analyses which included studies which did not document treatment fidelity or adhere to all the principles of ASI and therefore also included sensory integration interventions (see below; Schoen et al., 2019). Earlier reviews, for example, Case-Smith et al. (2015) and Watling and Hauer (2015), therefore failed to draw conclusions about the effectiveness of ASI. Schoen et al.'s (2019) more recent systematic review, which only included studies which met the criteria for ASI, however, indicates that ASI meets the criteria for evidence-based practice for children aged between 4 and 12 years of age.

Sensory-based interventions may use one or more sensory stimuli as the main intervention, and therefore do not adhere to the core principles of ASI (Schoen et al., 2019). These interventions are generally adult directed, thus passive co-operation of the child is required as opposed to active collaboration with the therapist which is an integral component of ASI (Case-Smith et al., 2015). While ASI sessions must take place in specialised environments, sensory-based interventions are designed to fit into the child's natural environments although they may also feature within an ASI session (Ashburner et al., 2014; Parham and Mailloux, 2015). Sensory-based interventions can therefore be provided during the child's day, or as required in response to the child's sensory processing state (Watling and Hauer, 2015). Similar to ASI, the hypothesis for the use of sensory-based interventions is that systematic application of specifically chosen sensation can make a change in the child's arousal state (Parham and Mailloux, 2015). Activities which are considered to be examples of sensory-based interventions include the use of weighted jackets and bouncing on a therapy ball (Watling and Hauer, 2015; Schoen et al., 2019). These may also be utilised in conjunction with ASI to support the child's sensory modulation, as the sole OT intervention, or in combination with environmental accommodations (Ashburner et al., 2014; Parham and Mailloux, 2015; Bodison and Parham, 2018).

Outcomes for the use of sensory-based intervention strategies depend on the child's diagnosis and the intervention used. In general, it is reported that the use of sensory-based interventions can lead to improved attention, decreased challenging behaviours, and improved self-regulation (Parham and Mailloux, 2015). In reality, few studies have evaluated the effects of these interventions. The most researched sensory-based intervention, the use of a weighted vest to improve attention on task, did not, however, demonstrate the expected improvements. Use of a therapy ball was, however, found to be effective to improve attention although it is suggested that the use of therapy balls as sensory-based intervention is recommended after a thorough assessment in order to match the sensory-based intervention to the sensory processing pattern (Parham and Mailloux, 2015).

The third category of sensory processing interventions refers to environmental modifications which involve the use of sensory adaptations designed to support the child to participate (Ashburner et al., 2014; Bodison and Parham, 2018). The use of such strategies reflects a shift in thinking away from solely focussing on the remediation of sensory processing patterns to one which acknowledges the importance of modifying and adapting activities in context (Bagatell and Mason, 2015). Examples of environmental modifications include the dimming of lighting in a classroom (Bodison and Parham, 2018), or the use of headphones to minimise classroom noise (Ashburner et al., 2014). It has been suggested that universal design principles which include reducing room clutter (both visual and auditory), organising spaces and furniture to support improved understanding of what is expected may support regulation and therefore lead to increased participation and learning (Mostafa, 2008; Ashburner et al., 2014). Case-Smith et al. (2015) also refer to family implemented environmental modifications such as the use of structured routines. In a recent survey of OT's use of sensory processing interventions, environmental modifications and contextual interventions such as reducing task and setting demands were reported in approximately 10% of the responses (Thompson-Hodgetts and Magill-Evans, 2018). Few of these strategies

have, however, been empirically researched although the use of environmental modifications does have some empirical support for improving participation and also decreasing disruptive behaviours (Ashburner et al., 2014). .

Although some studies have found evidence for the use of sensory processing interventions, Dunn (2016) notes that improved scores on sensory processing assessments is insufficient. The author states that more important is that this evidence is linked to improved participation in daily activities, and therefore it is necessary to look to increased scores on other study measurements (Dunn et al., 2016). Case-Smith et al. (2015) note that sensory processing interventions may be used in combination with other interventions to achieve goals in other areas of the child's life.

1.6.3 Sensory processing and speech, language and communication interventions

While no studies have been identified in which sensory processing interventions were utilised in as part of multi-component interventions to support speech, language, or communication outcomes, Tung et al.'s (2013) study found that children with sensory processing difficulties and articulation disorders made slower progress in speech therapy sessions than those who presented as only having articulation disorders.

There has been some interest in how sensory processing difficulties could impact learning to use AAC systems in children with ASC such as, Maragioglio (2017) who described the development of a tablet case which was designed to support sensory regulation through the use of different textures which were built into the cover. No other studies were found which examined how sensory processing difficulties could affect learning how to use AAC systems in children with ASC. Furthermore, no studies were found in which sensory processing interventions were utilised as part of an AAC intervention package although it has been suggested by occupational therapists that combining sensory processing

interventions with other interventions could be beneficial (Case-Smith et al., 2015).

1.7 Factors which impact AAC outcomes

Systematic reviews and meta-analyses have been published which have specifically focused on variables which could impact the outcome of AAC interventions with children with ASC e.g., van der Meer et al. (2010), Ganz et al. (2011; 2014), and Logan et al. (2017). These provide the clinician with evidence about the effectiveness of interventions which can be used to support decision-making (Ganz, 2015).

1.7.1 Child characteristics

To date, the sensory processing patterns of children with ASC have not typically been reported in descriptions of participants in the existing AAC literature and therefore this was not referred to in these reviews. The impact of other child characteristics have, however, been considered, for example, the age of the child at intervention. Two meta-analyses reported that younger children with ASC are more likely to have better outcomes with aided AAC (Ganz et al., 2011; Ganz et al., 2014).

Apart from age, the results of Ganz et al.'s (2011) meta-analysis indicated that children with ASC who did not have any additional diagnoses were likely to experience better outcomes with AAC interventions than those who did. Although this did not directly refer to sensory processing difficulties, it does raise the question of how the presence of sensory processing difficulties could impact learning to use AAC systems. As interventions for sensory processing difficulties exist, a further question could be, whether on some occasions, AAC interventions should be adapted to accommodate sensory processing difficulties when they are present in individual children. Ganz et al. (2010) state that clinicians do encounter children with ASC who make slower progress in AAC interventions. In these situations it is unclear if the presence of sensory processing difficulties might

impact on the children's ability to learn to use AAC systems, as sensory processing patterns are not typically assessed as part of the AAC assessment process. Ganz et al. (2015) refers to the importance of matching the individual characteristics of children with ASC to different types of AAC although it is possible that the way interventions are provided could also be considered e.g., it could be possible that combining AAC interventions with interventions designed to support sensory processing could result in improved therapeutic outcomes.

Recently, Sievers et al. (2018) reviewed possible child characteristics which were likely to be predictors of AAC outcomes. In their systematic review, autism severity, language comprehension, and cognitive levels were examined as possible predictors of AAC outcomes although the authors stated that these were unlikely to have an interactive effect. In other words, the AAC outcome is likely to be the same regardless of the intervention used. Due to the limited number of studies and participants included in the review, the authors were unable to make any broad conclusions about the impact of these child characteristics.

Sievers et al. (2018) noted that assessment of cognitive levels can be difficult when the child with ASC has not yet developed an effective mode of communication. Apart from cognitive functioning, however, adaptive functioning is also considered to be an essential component of a comprehensive assessment of ASC (Klin et al., 1997). Some researchers argue that for the child with ASC, understanding the level of adaptive functioning is more important than cognitive functioning as it is an indicator of the child's ability to utilise those abilities in real life contexts (Sparrow and Cicchetti, 1985). According to Liss et al. (2001) adaptive functioning is considered to be a measure of skills which are required for functioning in everyday, natural environments. Klin et al. (2007) report that studies have indicated that for children with ASC, adaptive functioning can be lower than would be expected when compared to cognitive functioning e.g., Liss et al. (2001). Adaptive functioning includes motor skills as well as practical daily living skills such as hygiene and dressing skills. Of particular interest are

communication and social skills as difficulties in these areas are particularly relevant to the area of ASC (see Sections 1.1.1 and 1.1.4; Klin et al., 2007). Typically, children with ASC are likely to present with a pattern of deficits in these areas, with relative strengths in the area of daily living skills (Carter et al., 1998). It is possible, that similar to cognitive skills, adaptive functioning could be a predictor of AAC outcomes although this was not included in Siever et al.'s (2018).

1.7.2 Intervention approaches

Meta-analyses which have considered intervention approaches typically used when providing AAC interventions have also been conducted e.g., van der Meer et al. (2010). The results of van der Meer et al.'s (2010) review indicated that AAC interventions can typically be classified into two categories: behavioural approaches and naturalistic approaches. Behavioural approaches arise from the field of ABA and often utilise prompting procedures to support learning to use the AAC system e.g., studies by Flores et al. (2012) and van der Meer et al. (2012; 2013). According to Logan et al. (2017) naturalistic approaches such as Enhanced Milieu Teaching which was used in Olive et al.'s (2007) study make use of other strategies, for example, following the child's lead within play scenarios, and using the child's preferred items and activities. Environmental strategies to support communication opportunities such as pausing within routines, and the use of waiting as a strategy to elicit spontaneous communication are also utilised (Kaiser and Wright, 2013). It has been suggested that behavioural techniques which are incorporated into everyday scenarios can also be used for AAC interventions and will more likely result in real consequences (Logan et al., 2017).

1.7.3 The therapeutic alliance as a factor influencing AAC interventions

Within the area of speech and language therapy, a small number of papers e.g., Ebert and Kohnert (2010) and Manning (2010) have discussed the possibility that the outcomes of interventions could be impacted by how the interventions are carried out. Ebert and Kohnert (2010) state that there is evidence from the field of counselling psychology that some clinicians are more successful than others at

achieving therapeutic goals. Bernstein Ratner (2006) noted the importance of making a distinction between 'therapies' and 'therapists' discussing the dangers of considering the outcomes of intervention studies without considering the role the clinician might play in achieving those outcomes. This is because there is a possibility that the clinician could influence the outcome of treatment independent of the treatment itself although this is still an emerging field within speech and language therapy (Ebert and Kohnert, 2010; Ebert, 2018).

Much of the debate on the role of the clinician within the intervention process originates from the common factors model which has emerged from the field of psychotherapy (Bernstein Ratner, 2006). This model provides a framework for which treatment components are most likely to contribute to positive outcomes (Messer and Wampold, 2002). These components are generally divided into two groups: 'specific ingredients' and incidental treatment aspects also referred to as 'common factors' (Ebert and Kohnert, 2010). Specific ingredients refer to the aspects of the treatment which are theoretically motivated. Common factors, on the other hand, refer to intensity and duration of treatment, clinician's expectations as well as the clinician-child relationship (Manning, 2010). The clinician is therefore potentially considered as a common factor which can influence the outcomes of the intervention (Ebert and Kohnert, 2010).

In Ebert and Kohnert's (2010) study, results indicated that SLTs working across the field of speech and language therapy placed a high value on the clinician-client relationship suggesting that this could be particularly influential in treatment outcomes. Duchan and Kovarsky (2011) and Nelson (2011) have written about the importance of building quality relationships to achieve success within the field of speech and language therapy. Manning (2010) refers to the clinician-child relationship as a therapeutic alliance. The establishment of a therapeutic alliance, also referred to as the therapeutic relationship refers to the goals of intervention, the tasks utilised to achieve these goals, as well as the bond between client and clinician (Bordin, 1979). In the psychotherapy literature, it is the quality of the

client and clinician bond that is the most consistent predictor of outcomes (Wampold, 2013). Freckmann et al. (2017) state that the bond within the therapeutic alliance refers to the emotional concepts such as trust, respect, and empathy. The authors also state that creating the bond is dependent on the SLT's communication skills, both verbal and non-verbal. Fourie et al. (2011) note that the therapeutic alliance may be even more important in interventions provided to children as failure to establish this relationship may lead to poor therapeutic outcomes.

Within the field of speech and language therapy, studies have evaluated client perspectives of clinician-client relationships in the field of stuttering e.g., Plexico et al. (2010). In this study, adult participants with a diagnosis of stuttering perceived clinicians to be more competent when they were able to promote an effective therapeutic alliance. This included the clinician's passion and motivation for supporting the client. Furthermore, the authors note that the characteristics of the therapists described in their study may apply to clinicians working with other communication disorders.

Fourie et al. (2011) explored the therapeutic alliance in speech and language therapy through semistructured interviews with six children aged 5-12 years and found that positive bonds were created in an atmosphere of fun and play. Fourie et al. (2011) also discussed how the potential power differential between child and adult is mitigated against by offering the child choices in sessions in order to provide a sense of empowerment.

Other researchers, have explored the perspectives of parents in creating therapeutic alliances e.g., Ebert (2018). This is important as parents play an important role in treatment success as they also form a relationship with the clinician (Shirk et al., 2011). In Ebert's (2018) study, parents viewed the child-SLT bond and the clinician's communication skills as two areas which enhanced the

relationship between the child and the clinician. Parents also valued specific clinician qualities including flexibility, and being invested in achieving outcomes.

The research on how the therapeutic alliance might impact interventions which specifically targets children with ASC is extremely sparse (Klebanoff et al., 2019). In Klebanoff et al.'s (2019) randomised control study children with ASC aged 7-14 years were contrasted with a comparable group of typically developing children aged 5-12 years all of whom were receiving cognitive behaviour therapy. In this study, therapeutic relationships were rated lower by both the children and therapists for the ASC group. The authors note that difficulty in forming social relationships is a defining feature of ASC and that this may therefore negatively impact the therapeutic alliance. They conclude that it is the clinician who must find ways to foster a positive therapeutic alliance with the child with ASC and that putting effort into forming such a relationship is likely to lead to positive therapeutic effects.

Klebanoff et al. (2019) conclude that the therapeutic alliance should be considered as a possible core component of evidence based interventions for children with ASC. While this literature comes from the area of psychotherapy, it is possible that this could be extended to clinicians working with minimally verbal children with ASC. Hull (2011) also refers to the importance of the therapeutic alliance with children with ASC given their communication and social interaction difficulties. To date, however, no published research was found in which young non-verbal children with ASC were participants. Similarly, no relevant literature was found in relation to the field of AAC. Beukelman and Mirenda's (2013) Participation Model refers to the need to ensure that communication partners have the skills and abilities to understand, use and provide the necessary support to optimise AAC system use. This, on some level infers some kind of therapeutic alliance between the clinician and these communication partners although no research evidence was found on this topic or that of children with ASC and the field of AAC.

McNaughton and Light (2013) note that it is rare that the provision of an AAC system immediately results in an effective communication system. They state that effort is required to support learning to use the system. Light and McNaughton (2012a) have also stated that although evidence for AAC interventions is positive, there are still a group of minimally verbal children for whom learning to use AAC systems continues to present a challenge. While exploring AAC system characteristics such as the organisation of vocabulary on visual displays is important, it might also be important to consider how AAC interventions are currently provided. This includes consideration of the characteristics of children with ASC which could be extended to include sensory processing differences and which may impact on children's learning. Furthermore, given the social-communication difficulties of these children it is also important to consider how therapists can support the building of therapeutic relationships when working to support AAC use with the children themselves, who are non-verbal and have a diagnosis of ASC as there is currently no literature on this subject. It is possible that the building of the therapeutic relationship with a child with ASC may be even further compounded when sensory processing difficulties are present. Fourie et al. (2011) state that the bond formed within the therapeutic alliance serves as a catalytic context for the achievement of therapeutic goals. Ultimately, therefore, if the goals of AAC interventions are to support improved communication outcomes for children with ASC it is important to consider all aspects of the intervention process and this includes the clinician's role in implementing these interventions.

This chapter has outlined some of the factors which could influence how the child with ASC learns to use a VOCA. Initially, this chapter focussed on AAC system considerations with specific attention to aspects of the method of language representation. The evidence for the organisation of vocabulary with particular emphasis on grid layouts versus VSDs was presented. In considering the factors which could impact the progress of children with ASC within AAC interventions within child characteristics were considered with particular emphasis on the potential effect of sensory processing difficulties on learning to use a VOCA.

Finally, this chapter also considered the clinician's skills as another possible influencer of how the child progresses in AAC interventions in considering how the therapeutic relationship between therapist and child which could also be relevant to the success of AAC interventions.

1.8 Research questions

The overarching purpose of this research was therefore to explore factors which could lead to improved clinical outcomes when making decisions and providing AAC interventions to children with ASC. The main question asked was:

> How can SLTs improve clinical outcomes when making decisions for AAC interventions for children with ASC?

The sub questions were as follows:

1. How do the two visual display layouts: a VSD or a grid display impact on how minimally verbal children with ASC learn to request using a VOCA?
2. How do the individual characteristics of children with ASC impact learning to request with a VOCA?
3. What aspects of AAC interventions should be considered during the decision-making process for children with ASC?

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Chapter 2. Methodology

2.1 Purpose of Chapter 2

This chapter presents the methodology which underlies Studies 1-4 which are presented in Chapters 3-6. This chapter therefore serves to present the guiding principles utilised to underpin this research. In doing so, this chapter provides a rational for why the methods were chosen for each study. This includes a description of the data collection method and an explanation of how the data was analysed.

2.2 Purpose of the present research

The research presented in Chapters 3-6 describes four studies which together were designed to address the overarching research question pertaining to how speech and language therapists (SLTs) can improve clinical outcomes when making decisions for augmentative and alternative communication (AAC) interventions for children with autism spectrum condition (ASC). The overall purpose of these four studies was to provide additional knowledge to the existing evidence base on how SLTs can improve clinical outcomes when providing AAC interventions to children with ASC. To do this, it was necessary to take a multi-faceted view of the AAC intervention process which included the AAC device features, the child characteristics, and the clinician. Two studies (Studies 1 and 2) were therefore designed to study the effects of vocabulary organisation on the display of voice output communication aids (VOCAs). The impact of child characteristics was examined once Studies 1, 2 and 4 were implemented. Furthermore, the caregivers of the participants who took part in Study 2 were provided with an opportunity to give their opinions of the effects of differing organisation of vocabulary in Study 2. Study 3, an interview with an occupational therapist (OT), was utilised to corroborate the results from Studies 1 and 2, and to support the generation of new theory on how the outcomes of AAC interventions could be improved. Study 3 was, therefore, designed to target both the impact of child characteristics, and the clinician in the provision of AAC interventions. Apart

from the single case experimental design (SCED) in Study 4, a focus group was also implemented which focused on ways the clinicians who implemented the SCED could be influencing the intervention outcomes. The results of all four studies are discussed with a view to answering the overarching research question in Chapter 7.

2.3 Introduction

A wide range of research designs are suitable for use within the field of AAC and the chosen design is dependent on the research question (Kent-Walsh and Binger, 2018). This research project is a reflection of this as it involved both quantitative and qualitative methods as well as a mixed methods design. Each design was chosen with a view to answering the overarching research question. The choice of research method for each part of the research project was also determined by the research questions generated as the overall project progressed and explored new areas.

Quantitative methods of research are systematic with an empirical basis thus specific questions are formulated and information is gathered to obtain measurable and observable data on variables (Creswell, 2014). Through quantitative research designs theories and hypotheses are proposed and developed with measurement forming the keystone of such research (Pierce, 2013). This type of research is about testing theories deductively, typically from existing theory (Creswell, 2014). In a recent review of AAC research, Kent-Walsh and Binger (2018) stated that the use of quantitative research practices in the field of AAC has been long established. Furthermore, Schlosser and Raghavendra (2004) have proposed a model for evidence based practice (EBP) which they suggest should be utilized by practitioners in the field of AAC. The authors suggest the integration of three areas to inform practice: clinical expertise, stakeholder perspectives, and best and current research practice. Within the area of best and current research practice, the authors propose a hierarchy of evidence to inform

intervention selection which consists generally of quantitative research studies thus underscoring the importance of this type of research within the field of AAC.

It has also been suggested; however, that qualitative research methods can be useful in order to explore new areas within the field of AAC (Balandin and Goldbart, 2011). Qualitative research is an approach which focuses on the understanding and meaning of the participants' experiences (Merriam and Tisdell, 2015). This style of research typically involves an inductive approach where the analysis of the data builds from particulars to general themes which are then interpreted by the researcher (Creswell, 2014). The process then supports the generation of new theory from the data from which hypotheses can be developed (Rusinová et al., 2009). Qualitative research methods can be used to define preliminary questions which can then be addressed in a quantitative study (Greenhalgh and Taylor, 1997b). Qualitative research methods have also been utilised to provide insight into quantitative data thus aiding in the interpretation of findings from these studies (Morse, 2003). Kent-Walsh and Binger (2018) state that the range of research designs utilized within the field of AAC has expanded particularly in the use of qualitative designs. More recently published research in this field which was analysed using qualitative methods has included the use of semi-structured interviews and focus groups e.g., Hajjer et al. (2016) and Caron and Light (2016).

According to Kent-Walsh and Binger (2018) mixed methods research designs have also recently been employed in AAC research e.g., Tönsing and Dada (2016) who used a concurrent mixed methods survey design to explore teacher's perceptions of the implementation of AAC. Mixed methods designs involve collecting data which is both qualitative and quantitative in nature and are typically used because it is felt that neither quantitative nor qualitative data alone will sufficiently answer the research question (Creswell, 2014). In such research, the data is typically integrated and the researcher then draws on the combined strengths of the two sets of data to understand the research problem (Creswell, 2014). Tashakkori and

Teddlie (2003: ix) have suggested that mixed methods research is the 'third methodological movement'.

2.4 The current research study

This research study included four phases which utilised a range of research methods and are visually presented in sequential order in Figure 2.1. The research method and design chosen for each individual study were driven by the research questions formulated at the outset of the project. Additional questions were also generated at each stage of the research project as the results of one study led to new questions (Figure 2.2). The data collection occurred over four phases: Study 1, Study 2, Study 3, and Study 4. As different questions necessitate the use of different research approaches (Gast and Ledford, 2014), a multimethod design was taken in order to answer the overarching research question:

> How can SLTs improve clinical outcomes when making decisions for AAC interventions for children with ASC?

In using a range of methods it was possible to offset the weaknesses of both quantitative and qualitative research by utilising the strengths of each method (Creswell and Plano Clark, 2018). According to Castro et al. (2010) both quantitative and qualitative methodologies have strengths as well as limitations and it is a mixed methods approach which can potentially bridge these limitations.

A SCED in which participants with ASC were taught to request with a VOCA using two different display layouts was designed for Study 1. The same study was then systematically replicated with some adaptations for Study 2. Adaptations to Study 2 included a change in the participant recruitment criteria to include sensory processing difficulties in conjunction with the ASC diagnosis. Furthermore, AAC interventions were combined with an individualised programme of intervention designed to address each participant's sensory processing needs. Social validity was also included in Study 2 to obtain parental views on the AAC interventions. On

completion of Study 2, a qualitative study, Study 3, which involved a semi-structured interview, was implemented for two reasons: firstly to provide triangulation of data for the previous two studies, and secondly to generate new theories. In the final study, Study 4, a mixed methods study was designed in order to confirm (or reject) new theories which were proposed as a result of Studies 1, 2, and 3, and to generate further theory.

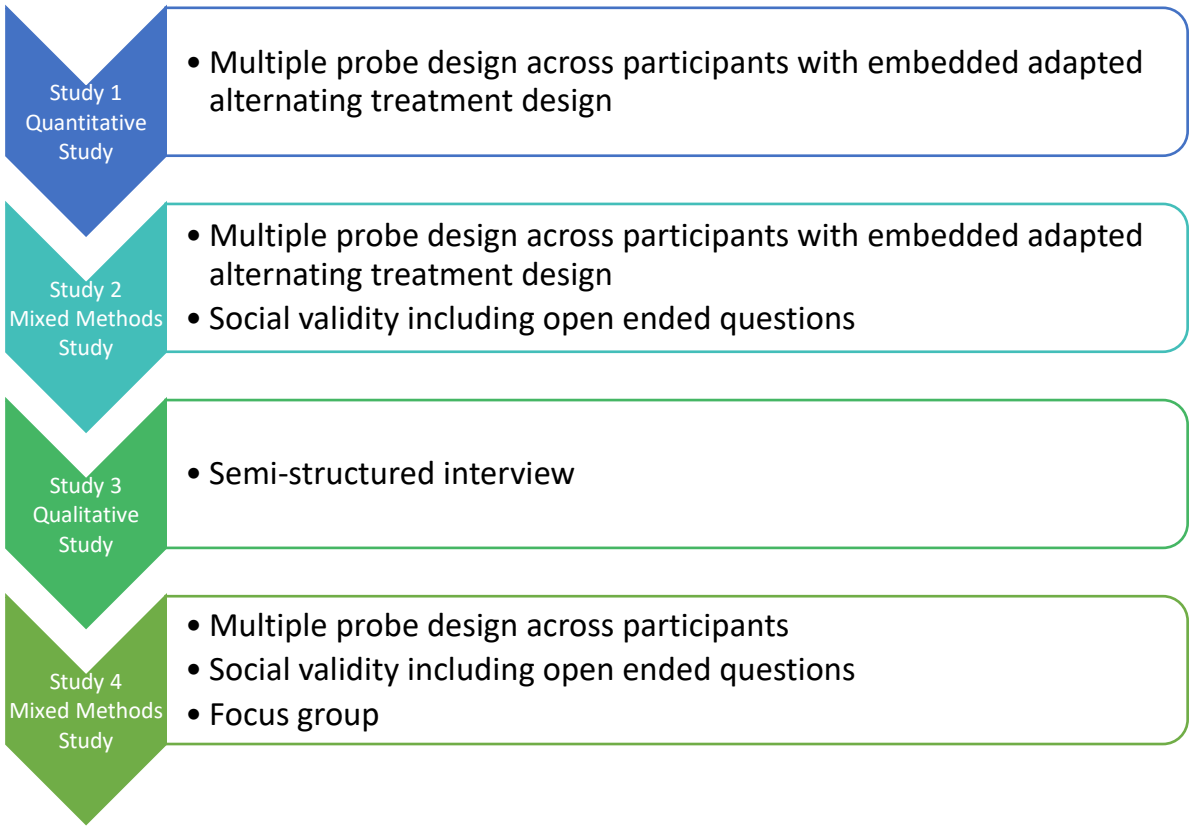

Figure 2.1 Overview of methods utilized in the research project

The epistemological stance taken to answer the overarching research question was a pragmatist one (Burke Johnson and Onwuegbuzie, 2004; Creswell and Creswell, 2017). According to Creswell and Plano Clark (2011) mixed methods research can involve designs which involve the collection, analysis and mixing of both quantitative and qualitative methods in a series of studies in order to be able to answer the overarching research question. In taking a mixed methods

approach, the present research began with an assumption that there was a need to collect different types of data in order to provide a more complete understanding than would have been possible with either solely quantitative or qualitative methods. This is possible because researchers who utilise mixed methods advocate for the use of whatever methodological tools are necessary to answer a research question (Tashakkori and Teddlie, 2010). In doing so, the researcher is free to draw on the strengths of both quantitative and qualitative research methods and therefore choose the mixture of methods which best suits the overarching research question (Burke Johnson and Onwuegbuzie, 2004).

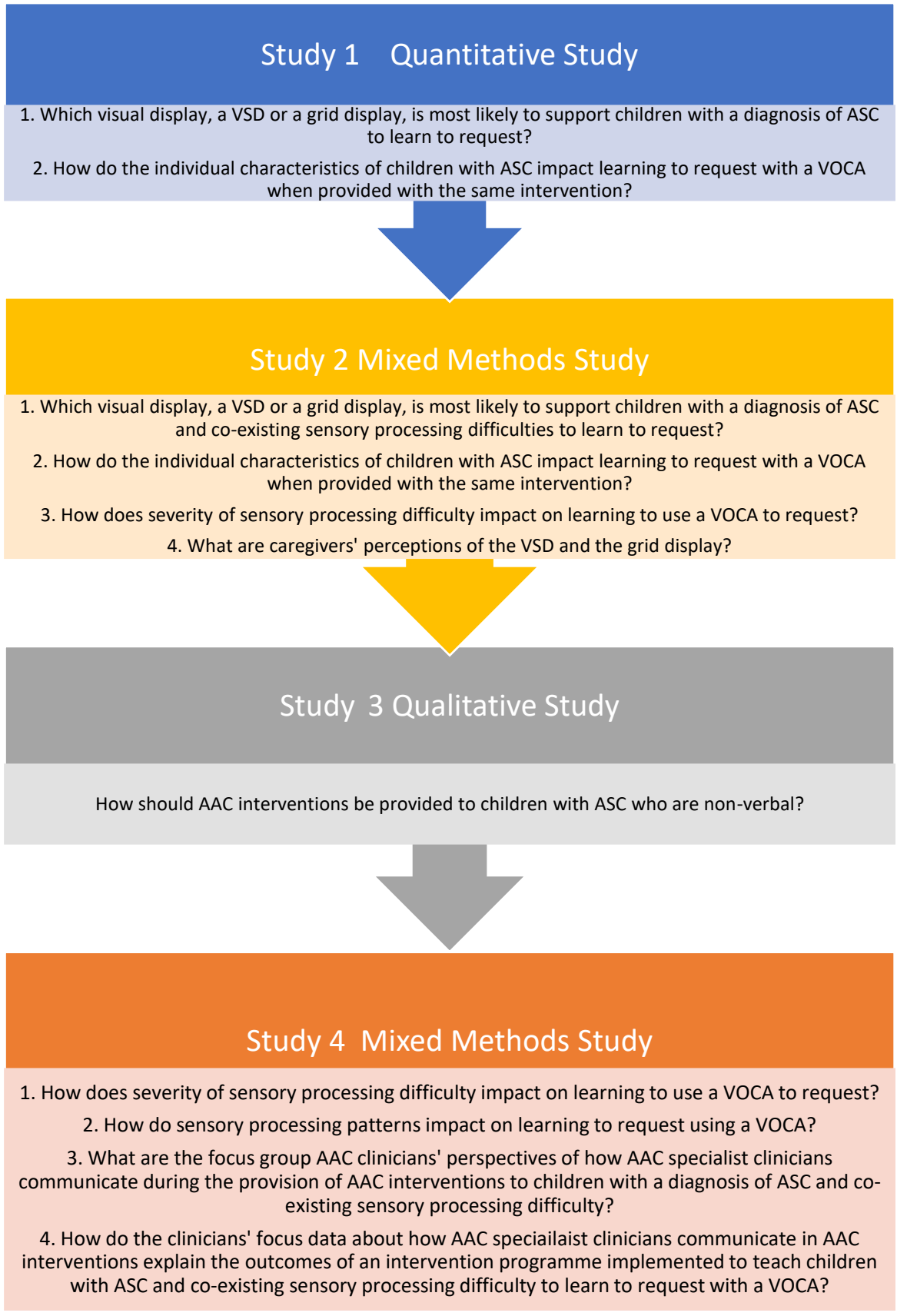

Figure 2.2 Overview of each study and main research questions

The next sections of this chapter will focus on the research design of each of the studies undertaken as part of the overall research project. This will include the study design for each study and the reasons for the choice of design, participant recruitment; and the data collection and analysis for each study. Reliability and validity will be included for quantitative studies. For the qualitative studies, strategies to enhance the credibility and trustworthiness of the study are presented.

2.5 Ethics approval and consent

Ethical approval for all four studies was granted from the Ethics Committees at Manchester Metropolitan University, UK and the University Research Ethics Committee at the University of Malta (see Appendix 1). Permission was also granted from the Ministry of Education in Malta (Appendix 1).

Parents signed a consent form giving permission for their children to participate in the study (Appendix 2). In Studies 1, 2 and 4 in which participants were children, consent was inferred from their assent to participate in the sessions. Studies 2 and 4 involved adults who were therapists as participants. Consent forms can be found in Appendix 2.

Further ethical considerations regarding each of the four studies is discussed in sections 2.6-2.8.

2.6 Studies 1 and 2: SCED studies

The overarching research question for this thesis concerned decision-making for AAC systems for children with ASC. In the initial stages of the research, the first question was narrow in focus: specifically relating to the organisation of the vocabulary on the visual display of the high tech AAC device. This was relevant to the overarching research question which concerned the decisions which need to be made by a clinician who is considering implementing AAC with a child with ASC. The main aims of Study 1 and Study 2, therefore, focussed on the efficiency of

one type of visual display over another: a visual scene display (VSD) and a grid display. According to Schlosser (1999a), efficiency refers to whether one intervention is more effective than another, and this can be measured in many ways including: number of trials, cost, intervention time, and number of errors during the intervention. Efficiency is one element of efficacy; an umbrella term which also includes the concept of effectiveness. The effectiveness of an AAC intervention refers to the demonstration of behaviour change which is a direct result of the treatment. Light et al. (1998) note that efficacy studies within the field of AAC are particularly important as they provide support for best practices as well as guiding clinical interventions.

In view of the literature on the subject, apart from establishing that the treatment protocol designed for the study was effective, the main aim of Study 1 and Study 2 was to compare the two visual displays: a VSD and a grid display, while learning to request with a VOCA. Another aim of Study 1 and Study 2 was to explore how the characteristics of children with ASC could be associated with a differential response to the same intervention. Study 2 also included two further aims not included in Study 1: firstly, to explore the impact of severity of sensory processing difficulty on learning to use the VOCA to request. This was due to the inclusion of children with sensory processing difficulties as participants in the study, as this also potentially impacted how the AAC interventions were provided, and secondly, to explore caregiver perceptions of the interventions and the two visual displays.

The next sections present the quantitative methodology which was used to compare the two visual displays and to explore the impact of child characteristics including sensory processing on learning to request. The qualitative methodology which addresses the parental perceptions of the interventions is discussed in the section *Social Validity.*

A quantitative research design was selected for Study 1. As Study 2 included a qualitative strand the quantative research design utilised forms a part of this study

which can be viewed as mixed methods (Creswell & Plano Clark, 2018). In both studies, a quantitative research design was chosen to compare the two visual displays as this design is used to test hypotheses (Creswell, 2013). Given the state of research evidence presented in the literature review in Chapter 1, at this stage of the project, for Study 1, it was hypothesised that children with ASC, similar to typically developing children, would learn to communicate faster with a VSD layout. Within the realm of quantitative research designs two broad categories of designs are evident: group designs and SCEDs.

Group designs commonly include a large group of participants who are assigned to two or more treatment conditions (Gast and Ledford, 2014). Participant characteristics are generally controlled for to ensure that each treatment group is as homogenous as possible (Morgan and Morgan, 2008). SCEDs, on the other hand, typically involve one participant or a small group of participants each serving as their own control as each individual participant is exposed to both the control and the treatment condition (Gast and Ledford, 2014). In a SCED, the comparison takes place within each participant rather than between groups as is typically found in a group study (Smith, 2012).

Although randomised control trials (RCTs), in which participants are randomly assigned to one of two treatments are often considered to be the 'gold standard' for quantitative research, group designs are rare in the field of AAC, and RCTs are even rarer (Byiers et al., 2012; O'Gorman et al., 2013). In terms of research designs for individuals who require AAC systems, it has been stated that group designs may not be the most appropriate research design (Schlosser and Raghavendra, 2004). This is because of the heterogeneity and low incidence of individuals who require AAC systems (Schlosser, 2005). Kadzin (2011) has also argued that there are specific characteristics of SCEDs which can make them a reasonable alternative to group designs. One particularly important characteristic of a SCED is that it can be used to establish evidence based practices as it documents experimental control (Horner et al., 2005; Smith and Iadarola, 2015).

Typically, SCEDs are utilised to answer research questions about whether the introduction of an intervention (the independent variable) is associated with a change in behaviour, also referred to as the dependent variable (Romeiser-Logan et al., 2017).

Studies 1 and 2 were designed as SCEDs and such designs are highly prevalent in both fields of AAC as well as of ASC (Figures 2.3 and 2.4; Schlosser, 2003b; Smith and Iadarola, 2015). The use of a SCED strategy appears to be the preferred option for research within the field of VOCAs and ASC (Schlosser and Koul, 2015). The SCED was chosen as a research design for Studies 1 and 2 for a number of very specific reasons: apart from answering questions about the impact of the independent variable on the dependent variable, the SCED may also be utilised to answer questions about how the characteristics of participants which may be associated with differential response to the same intervention (Romeiser-Logan et al., 2017). The SCED allows the researcher to observe each participant on an individual level (Gast and Ledford, 2014). This was a particularly important aspect of the research as this project is about making decisions for children with a diagnosis of ASC. This group of children present as a heterogeneous group, thus decisions about AAC devices and interventions are made specifically for the individual (Schlosser and Koul, 2015). Because SCEDs provide information on the child's performance at such a level, it is possible to examine the characteristics of each participant in relation to the introduction of treatment (Horner et al., 2005). The data generated from a SCED strategy are therefore more likely to provide information on child characteristics which could influence the decision-making process than a group design would. This is because in group designs the results are grouped so the individual effects of the treatment are masked and it may not be clear for which child characteristics the intervention is most appropriate (Byiers et al., 2012). Furthermore, given the heterogeneity of this group of children it would have been difficult to recruit the large numbers of participants required for a large scale study. A further advantage of utilizing this design is that it is possible to carry out a SCED project in a clinical setting (Byiers et al., 2012). Byiers et al

(2012) state that it is desirable to carry out research projects in real life settings to establish that the treatments are viable before implementing them on a larger scale such as in a RCT. Furthermore, the choice of research design allowed the researcher to adjust the treatment if need be e.g., in the event that a participant does not make progress (Byiers et al., 2012; Smith and Iadarola, 2015). This was an important aspect of this research as the treatment protocol developed to teach requesting had not been previously used to teach requesting using a VSD. Adjusting the treatment is possible as each participant serves as his own control (Horner et al., 2005). Finally, the SCED documents data on a step by step basis allowing the researcher to note fluctuations in response to the treatment (Horner et al., 2005).

A variety of design types are possible within the category of SCEDs. Byiers et al. (2012) suggest six primary designs each of which is suitable for answering a specific type of research question and comes with its own advantages and disadvantages (see Table 2.1). The multiple-probe design (MPD), a variation of a multiple-baseline design (MBD), first described by Horner and Baer (1978), was selected because this particular design is suited to answering questions regarding the effects of a single intervention. These designs are well suited to studies which do not require a withdrawal of an intervention which has been effective and are therefore appropriate when teaching a child non-reversible behaviours (Gast et al., 2014). Gast (2014b) notes that changes in behaviours which are referred to as non-reversible are not truly permanent but these changes are likely maintained when the intervention is withdrawn. Such a design is therefore appropriate for behaviours where a return to baseline is unlikely to occur in the absence of intervention and is also considered undesirable (Byiers et al., 2012). In Studies 1 and 2, learning to request with a VOCA was considered to be a behaviour in which a return to baseline was unlikely to occur once the intervention was withdrawn and this was also considered to be undesirable.

Table 2.1 Features of different SCEDs

Type of SCED	***Characteristics***	***Advantages***	***Limitations***
1. Pre-Experimental (AB) design	• Made up of 2 phases: the A (baseline) phase and the B (intervention) phase in which the dependent variable is measured repeatedly	• Provides preliminary data about the effects of an intervention under clearly described and controlled environmental conditions • Can be used in situations when time and resources are limited	• Lacks replication of experimental effect so it is impossible to state that changes in behaviour are a result of the introduction of the independent variable • External factors may be responsible for changes in behaviour
2. Withdrawal (ABA & ABAB) designs	• ABA design is made of 3 phases: the A (baseline) phase, the B (intervention) phase followed by the return to baseline A phase in which the intervention is withdrawn • ABAB is the same as the ABA design with the addition of a second B phase in which the intervention is re-implemented	• ABA design provides an opportunity to demonstrate the effects of the introduction of the independent variable as it is withdrawn in the second A phase • ABAB demonstrates further experimental control when the intervention is reintroduced in the second B phase	• Can only be used with reversible behaviours as it assumes that the target behaviour being taught is reversible and will return to pre-intervention levels once the independent variable is withdrawn • Ethical issues with withdrawing an apparently effective intervention
3. Multiple baseline (MBD) & multiple-probe designs (MPD)	• Used to answer research questions about the effects of an intervention across 3 or more participants, conditions, or settings, each of which is referred to as a tier • Baseline data collection begins simultaneously for each tier • Intervention is introduced in a staggered fashion	• Does not require withdrawal of intervention due to replication of experimental effect across conditions • ATD can be used with a wide range of interventions • AATD is practical for behaviours that cannot return to baseline	• Generalisation effects must be carefully controlled to minimise threats to internal validity • ATD is restricted to reversible behaviours • AATD requires behaviour sets which are of equal difficulty

	• MPDs are a variation of MBDs in which data collection is replaced by intermittent probes in the baseline phase		
4. Changing criterion designs	• Appropriate for answering questions about the effects of an intervention on one or more dependent variables • The target behaviour is observed in baseline. This is followed by a series of treatment phases which is associated with a stepwise change in criterion rate of the target behaviour	• Ideal for behaviours which already exist in the participant's repertoire • Ideal for behaviours in which it is not realistic to expect a large, immediate change to occur on the introduction of the independent variable • Does not require withdrawal of treatment • Requires only one participant, behaviour or setting	• Only interventions in which consequences for meeting or not meeting the established criterion levels can be used • Some level of target behaviour must be present before the study begins • Not appropriate for severe or life threatening behaviours because there is no immediate change
5. Multiple Treatment designs	• Designed to compare two interventions using an extension of the ABA design by following with a CAC design in which B and C are two interventions • C can refer to a modified intervention or a new intervention	• Ideal when an ABA or ABAB study is planned but the effects of intervention were not as hoped • Allows for comparison between 2 treatments • Strong internal validity • Can be used to assess the effects of additive treatment components	• Only allows for comparison of adjacent conditions • External validity may be compromised by the potential for multi-treatment interference • Cannot be used with a behaviour which is irreversible • Difficult to extend beyond 2 treatments

6. Alternating treatments (ATD) & adapted alternating treatments design (AATD)	• Designed to compare two interventions • ATD involves rapid alternation of 2 or more intervention conditions typically beginning with a baseline phase • In the ATD effects are assessed of different independent variables on a single dependent variable • AATD similar to the ATD but a different set of responses is assigned to each independent variable	• Both ATD and AATD are suitable for comparing the effects of two or more interventions • Multiple comparisons can be made in a relatively few sessions • AATD eliminates some concerns about multiple-treatment interference	• ATD is susceptible to multiple treatment interference because the dependent variable is exposed to each of the treatments • Generalisation across behaviours is a potential threat

In general, the main purpose of the SCED is to document the relationship between the independent variable (the treatment) and the dependent variable (the observable behaviour) once the independent variable is actively manipulated (Horner et al., 2005). Specifically, the main goal of the MPD/MBD is to validate an intervention by demonstrating that it can generate some kind of effect on a behaviour across different behaviours, settings or participants. In Studies 1 and 2, this research design was utilised across the same behaviour, requesting using a VOCA, with eight different participants in total. Adding more participants to the design is desirable as there are more opportunities for the researcher to demonstrate the effect when an intervention is introduced (Wolery, 2013). Confidence in the results is therefore generated due to inter-subject replication because the same intervention is applied to a minimum of three participants thus increasing the generality of the findings (Gast et al., 2014). Studies 1 and 2 each involved four participants.

The MPD is utilised as a variation of the MBD to avoid the simultaneous and continuous data collection during the baseline phase which is typical of the MBD (Byiers et al., 2012). It is therefore the frequency of pre-intervention data collection which differs between the MBD and MPD (Gast et al., 2014). In a MPD, a plan is typically put in place to collect data intermittently prior to the introduction of the intervention. Horner and Baer (1978) suggest that this can be used as an alternative to unnecessary continuous baseline data collection. The MPD is unique in its design because a priori assumption is made that the behaviours being researched will not change without intervention (Wolery, 2013). In this study, it was considered unlikely that the participants would acquire the skill of requesting with the VOCA without direct intervention as the participants had not been previously taught to use a VOCA of any kind and thus a stable baseline was anticipated.

Studies 1 and 2 sought to answer two main questions and in this situation Ledford and Gast (2018) suggest that the combining of SCEDs is appropriate. The MPD

provided data to answer the first question: whether the treatment protocol developed for the study could successfully be utilised to teach the participants to request with the VOCA. This therefore, demonstrated that the treatment protocol was effective as effectiveness is defined as the demonstration of behaviour change due to the introduction of an interventions (Schlosser, 2003d). In order to answer the second question, of whether one visual display is more efficient than another, it was necessary to combine the MPD with another type of SCED. An adapted alternating treatments design (AATD) is one design which can be used to compare treatments and was therefore combined with the MPD in order to establish if one treatment: the VSD or the grid display was more efficient than another in terms of sessions and error rate (Sindelar et al., 1985; Schlosser, 2003d). The use of the combination design in this situation also served to strengthen the demonstration of experimental control (Ledford and Gast, 2018).

An AATD is one of four comparative designs which can be used to determine which of two effective treatments will result in the most efficient learning. Schlosser and Sigafoos (2006) note that this particular comparative design is frequently used to compare interventions in the field of AAC. It is typically used when a researcher asks 'is X intervention better than Y intervention?' and its purpose is to facilitate the learning of new behaviours (Wolery et al., 2014). In the present research the two interventions were two types of visual displays: the VSD and the grid display. This particular comparative design was chosen because it is suitable for behaviours which are unlikely to return to baseline following withdrawal of the intervention. The AATD is similar to an alternating treatment design (ATD) with one important exception: each of the two interventions is applied to separate but equal sets of behaviours that are of equal response difficulty but functionally independent of each other (Schlosser, 2003d). An example of this within the field of AAC is described by Boesch et al. (2013) who compared the efficacy of the PECS with a VOCA to increase natural speech production and social-communicative behaviour including eye contact, smiling and physical orientation. Three children with a diagnosis of ASC were taught to request

food items. The authors created two sets of equally reinforcing food items using a preference assessment. Each set of reinforcers was then allocated to each of the treatment conditions. The equal response difficulty of each set means that the same amount of intervention should be required to achieve the pre-set criterion (Holcombe et al., 1994). If criterion is achieved in both treatments then both are equally effective, yet differences between the two treatments may become evident when a comparison of efficiency indicators is made e.g., rate of acquisition, number of errors and sessions to criterion (Schlosser, 1999a).

The AATD was considered to be the comparative design best suited to answer the research question concerning the efficiency of a VSD versus a grid display which was of interest in Studies 1 and 2. There were, however, some issues which pertain to the internal validity of the AATD which needed to be considered during the planning phase. The issue of multi-treatment interference, in particular, refers to the influence one treatment has on another (Wolery et al., 2014). Barlow and Hayes (1979) historically refer to two types: sequence effects and carryover effects. The AATD is particularly vulnerable to sequence effects, which can be due to the comparison of treatments within the same participant. Because sequence effects are due to the influence of one treatment on another because of the ordering of experimental conditions, the starting order of treatments was randomised between participants to minimise this (Holcombe et al., 1994). Carryover effects on the other hand, are related to the influence of one treatment on the other treatment due to the nature of the initial condition (Wolery et al., 2014). The AATD was also chosen in order to avoid carryover effects which are particularly prevalent in the ATD (Tawny and Gast, 1984). In the AATD, such effects are minimised as treatments are applied to functionally independent behaviours of equal response difficulty (Sindelar et al., 1985). To minimise carryover effects two separate sets of reinforcers were therefore created for requesting purposes. This was done using a two stage reinforcer assessment process in which a reinforcer assessment interview was carried out with the parent of the participant (Appendix 3). Each set of reinforcers was then allocated to each

of the treatments: the VSD and grid display. The creation of two sets of reinforcers reduces the possibility of carryover effects from the treatment itself but does not eliminate carryover effects from other sources (Schlosser, 2003c). In order to minimise the possibility of other carryover effects, lengthening of the time between sessions was also used as a strategy by ensuring there were always more than two days between sessions (Holcombe et al., 1994). A further threat to internal validity known as cyclical variability refers to a specific type of data instability related to repeated and predictable patterns in the data series (Gast, 2014b). This was reduced by randomisation of the intervention sessions but with the stipulation that no more there was no more than two consecutive sessions of the same treatment condition (Wolery et al., 2014). Barlow et al. (2009) refer to the restraining of consecutive number of sessions within a condition as 'semi-randomisation'.

Study 2 was planned as a systematic replication of Study 1. Systematic replication of a single study may involve replicating the design with other participants with systematic modifications from the original design (Gast, 2014a). The planned changes included additional intervention sessions. The recruitment criteria was also modified to ensure that all the participants also had sensory processing difficulties as well as ASC. Interventions targeting sensory processing were also included in Study 2 in order to support learning to request with the VOCA. Assessment of social validity was a further modification which was included in Study 2 and is discussed in greater detail in *Social Validity*.

Participant recruitment: Characteristics and ethical considerations

Four participants were recruited from the ACTU (Access to Communication and Technology Unit) waiting list for each study: Study 1 and Study 2. ACTU provides services in the area of AAC in Malta for children and young adults under the age of 23 years. The inclusion criteria for Study 1 was a diagnosis of ASC prior to the study. All participants had to be under the age of 6 years and minimally verbal. This was defined as less than 20 words used for functional speech (Tager-Flusberg

et al., 2009). In Study 2, a further adjustment was made to the inclusion criteria to include children who had sensory processing difficulties in addition to the diagnosis of ASC.

Exclusion criteria included the presence of sensory perceptual impairments such as vision and hearing loss which could impact on learning to use the VOCA for communicative purposes.

Preschool aged children were chosen for this study because as noted by Schlosser and Koul (2015) there is limited research in the area of AAC and ASC for this age group. As the children were recruited in Malta, all the children were under the age of 6 years as children commence school after 6 years of age. On a functional level, all the participants were similar in order to replicate the introduction of intervention across all participants thus maintaining experimental control (Gast et al., 2014). Furthermore, the participants recruited attended different schools to avoid diffusion of treatment (Byiers et al., 2012).

All participants were recruited by the researcher who was also a clinician on the ACTU team. Hegde and Salvatore (2019) note that one ethical issue in the recruitment of participants could be the presence of more subtle forms of coercion which may take place when the researcher is also a clinician. In such situations, it is possible that potential participants may feel pressure to take part in the study. The authors suggest that it is important that all steps are taken to minimise such coercion. A number of safeguards were therefore put in place to ensure that the researcher behaved in an ethical manner. In Studies 1 and 2, and similarly for the SCED described in Study 4 (section 2.8.1), none of the participants were known to the researcher before they attended for their first screening appointment. The pressure to take part in the study due to a prior relationship between the family and researcher was therefore minimised. Furthermore, the researcher gave the family information which fully described the interventions that would be carried out as well as the purpose of the study to ensure that the parents knew the

maximum length of time in the study and that they understood what was expected of them during the sessions. The parents were also informed that they would be free to withdraw from the study at any time at which point they would be offered the typical ACTU service. Parents were given one week to make a decision to ensure that they had enough time to fully consider their participation in the study. Parents were advised they could contact the researcher and ask questions to further clarify their participation in the study. In this situation the researcher ensured that no reaction was given which would coerce parents to take part in the study. Furthermore, when asked what would happen if they chose not to participate in the study, parents were advised that they would be offered the usual ACTU service to ensure that families did not suffer punitive measures (Hegde & Salvatore, 2019).

Assessments

As the overarching research question related to how SLTs can improve clinical outcomes when making decisions for children with ASC who may benefit from AAC interventions, the issue of whom a particular intervention is effective for was of particular interest. In order to answer this question it is necessary to describe participants in detail beyond the inclusion criteria (Wolery, 2013). If there is variability in the participants' response to the same intervention it is then possible to analyse the child characteristics that could account for these differences (Gast and Ledford, 2014). This supports the researcher to make some generalisation of the results to individuals who are non-participants but have similar characteristics (Wolery, 2013). To gain greater insight into the characteristics of the participants four assessment tests summarised in Table 2.2 were administered. All assessment tests were carried out directly after the participants were recruited. The exception to this was the administration of the Short Sensory Profile in Study 1 which was carried out during the baseline phase as sensory processing patterns were not initially considered as participant characteristics which might be important for the study outcomes.

Table 2.2 Studies 1 and 2: Summary of assessments used

Assessment	***Area assessed***	***Mode of administration***
MacArthur-Bates Communicative Development Inventory	Early language and social communication	Caregiver administered questionnaire
Autism Diagnostic Schedule-2	Social communication severity	Direct administration with the child
Vineland Adaptive Behaviour Scales-2	Adaptive functioning	Caregiver interview
Short Sensory Profile	Sensory processing	Caregiver administered questionnaire

Early communication skills were assessed using the MacArthur-Bates Communicative Development Inventory: Words and Gestures (CDI-III: Words and Gestures; Fenson et al., 2007). This is a caregiver reported questionnaire of early language and social communication intended for typically developing children aged between 8 and 18 months but which has also been utilised with older children with a diagnosis of ASC (Luyster et al., 2007). This assessment is divided into two parts; Part I: Early Words, and Part II: Total Gestures (Fenson et al., 2007). The Total Gestures part is organised into two kinds of gestures: those that primarily involve social engagement and appear in the first 12 months, and those which appear at approximately 16 months and involve skills such as play and imitation. This assessment was chosen for administration as it can be difficult to quantify early communication skills using standardised tests on which it is likely that the children would score at floor (Charman et al., 2003). Furthermore, the Total Gestures part was the only section of the CDI-III administered as it is described as being particularly useful for assessing the communicative and social skills of children who have developed little or no expressive language as was the case in the present research (Fenson et al., 2007; Luyster et al., 2007). This assessment therefore gave a measure of early social-communicative skills which formed part of the picture of the child's communication skills. Other measures of

communication; receptive and expressive language were assessed using the Vineland Adaptive Behaviour Scales-2 (see below).

Social communication severity was assessed using the Autism Diagnostic Observation Schedule-2 (ADOS-2; Lord et al., 2012). Module 1, designed to be administered to children who are nonverbal or use little speech was administered by two clinicians (a speech and language therapist and an occupational therapist) trained to administer the ADOS-2.

The Vineland Adaptive Behaviour Scales-2 (VABS-2; Sparrow et al., 2005) a structured caregiver interview was administered to assess adaptive functioning. This instrument yields scores in four domains: communication, socialization, daily living and motor scales as well as a composite score referred to as the Vineland Adaptive Behaviour Score.

During the baseline sessions in Study 1 it was considered that sensory processing difficulties might be a potential influencing factor in the participants' progress in the study. The Short Sensory Profile (SSP; McIntosh et al., 1999) was therefore also administered by an OT. In Study 2, this assessment was carried out with the other tests in the pre-baseline phase. The SSP is a standardized parent questionnaire developed in order to identify children aged 3-10 years with sensory processing difficulties. Parents are asked to rate each of the 38 items using a 5 point Likert scale ranging from never to always. Seven section scores are generated: Tactile Sensitivity, Taste/Smell Sensitivity, Movement Sensitivity, Underesponsive/Seeks Sensation, Auditory Filtering, Low Energy/Weak, and Visual/Auditory Sensitivity. The profile also generates a total SSP score. An SSP score between 155 and 190 points is considered to be typical.

Procedures

The MPD utilised for Study 1 and Study 2 involved the following phases in sequential order: recruitment, pre-baseline, baseline, comparison (intervention),

post-intervention, and follow-up (see Figures 2.3 and 2.4 for Studies 1 and 2 respectively). A SLT (author of this thesis) and an OT were present for all sessions.

The recruitment phase served two purposes: firstly to ensure participants were recruited as per inclusion guidelines, and secondly to administer assessments to gain a more detailed description of the characteristics of each of the participants. The pre-baseline phase was utilised to assess each participant for reinforcers to be utilised during the other phases of the study. The baseline phase was used to assess pre-intervention aptitude for requesting behaviours using the VOCA. In keeping with the logic of the MPD, the baseline data collection began simultaneously for all participants (Byiers et al., 2012). The intervention was then introduced in a staggered fashion exactly one week apart, thus when the first participant commenced intervention the second remained in baseline for a further week. Introducing the intervention one week apart meant that no participant would have to spend long periods in baseline should any of the participants not make progress (Gast et al., 2014). Long periods in baseline would have been considered unethical as it was unclear how long it would take each participant to achieve criterion in order for the next participant to commence intervention (Gast et al., 2014). The independent variable introduced during the intervention phase was the use of prompting procedures designed for this study (see Intervention Protocol below). The frequency of spontaneous requesting was the dependent variable. Requesting was chosen for this study as this is recommended as a goal if it has not developed naturally and is an important skill in the early stages of communicative development (Sigafoos and Mirenda, 2002; Davidoff, 2017). Furthermore, Logan et al. (2017) state that teaching object requests is a developmentally appropriate goal for children with ASC who are minimally verbal. For both display conditions spontaneous requesting was defined as unsolicited picking up the VOCA, reaching towards the communication partner and then touching a cell on the screen to activate the voice output in exchange for a reinforcer. The post-intervention was identical to baseline thus the independent

variable: the prompting procedure, was withdrawn. This served as a maintenance phase and was similar to the follow-up phase which took place four weeks later. All data was recorded on sheets designed for the study (Appendix 4).

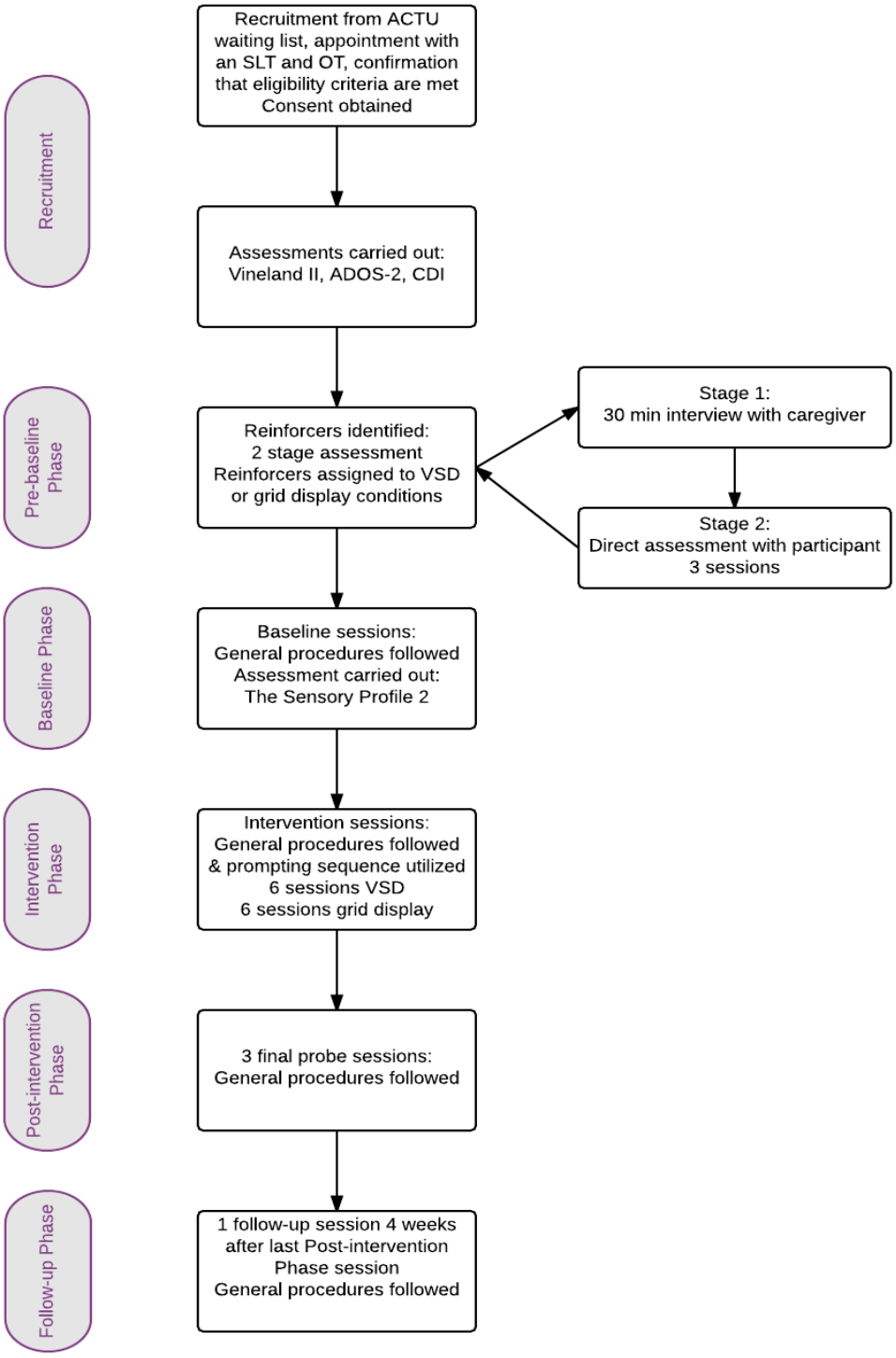

Figure 2.3 Study 1 design

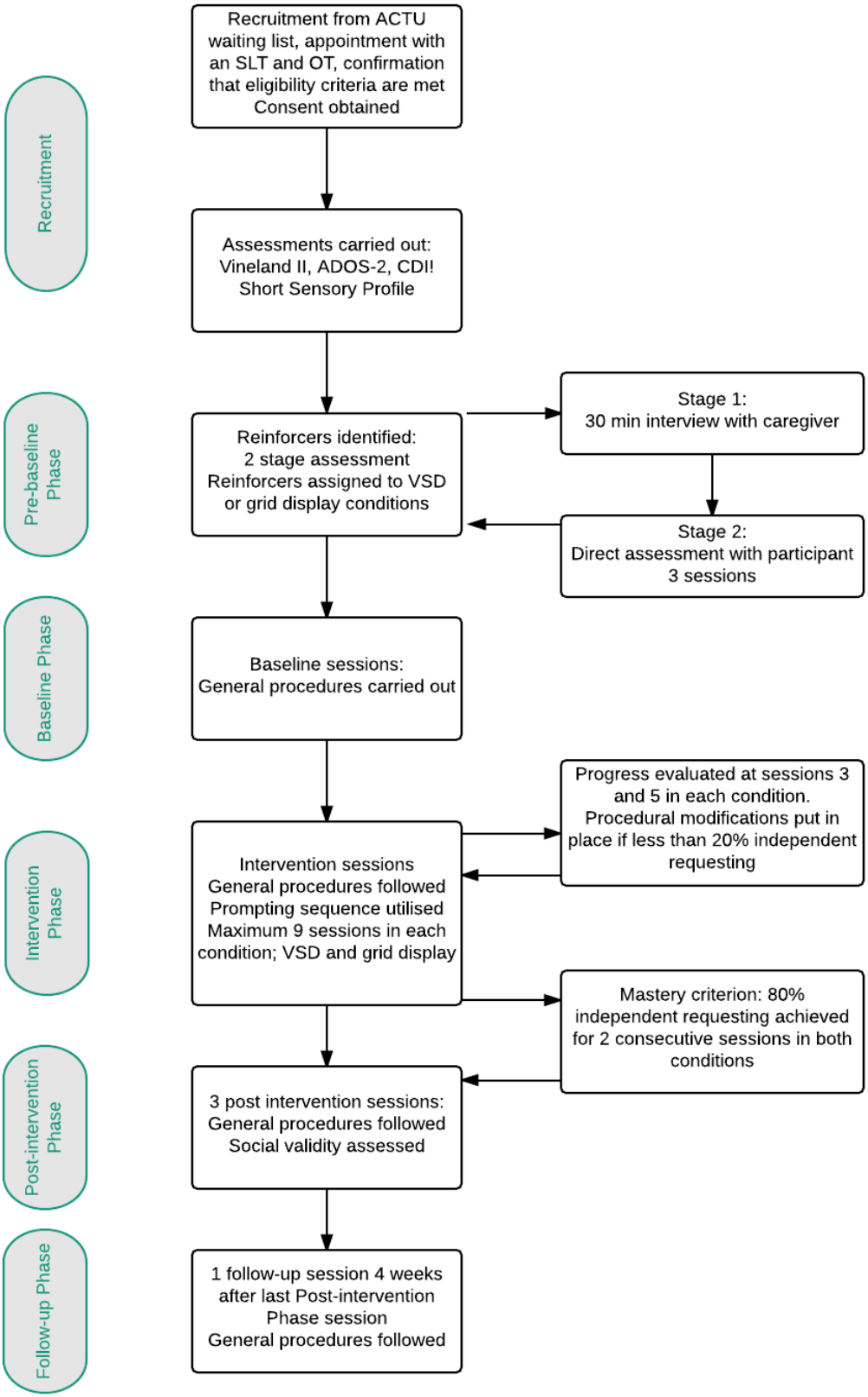

Figure 2.4 Study 2 design

Intervention protocol

The intervention consisted of a treatment protocol which was applied during the intervention phase only. In accordance with the logic of the AATD, the same treatment protocol was applied to both displays on the VOCA. The protocol based on principles of applied behaviour analysis (ABA) was adapted from Agius & Vance (2016) with the goal that the requesting behaviour using the VOCA would be performed independently (Table 2.2). The use of treatment protocols which draw on the principles of applied ABA is common in the field of AAC (Logan et al., 2017). MacDuff et al. (2001) state that the use of ABA principles such as prompts and fade-prompting strategies are important when teaching new skills to individuals with a diagnosis of ASC as cues such as modelling, spoken requests, or printed words are not as effective as when used with typical learners.

For both display conditions spontaneous requesting was defined as unsolicited picking up the VOCA, reaching towards the communication partner and then touching a cell on the screen to activate the voice output in exchange for a reinforcer. This requesting behaviour can be referred to as a behaviour chain which is further defined as a sequence of discrete behaviours which are linked together to execute the more complex or chained behaviour (Collins, 2012). When teaching a chained response, response prompts are often used (Libby et al., 2008). Response prompts provide an increased probability of correct responding thus providing the clinician with greater opportunities to provide positive reinforcement (Wolery and Gast, 1984). Systematic fading of response prompts is used to ensure that eventually the taught behaviour becomes prompt free (Libby et al., 2008).

Response prompts can include vocal instruction, modelling, and physical guidance (Libby et al., 2008). Physical prompting and fading also referred to as most-to-least prompting is the most widely used procedure for teaching response chains to individuals with ASC (Wolery and Gast, 1984). Libby et al. (2008) state that most-to-least prompting is likely to result in the least number of errors during

intervention. The authors also state that this is important as the child is more likely to learn from correct attempts, even if prompted, than from those made with errors. Furthermore Libby et al. (2008) state that the use of this particular strategy is likely to lead to less problem behaviour during the intervention. Moreover, it has been stated that this type of response prompting may be more effective with children who have poor imitative skills (Johnston, 2006).

Most-to-least prompting has been used in studies to teach VOCA use to children with a diagnosis of ASC e.g., Olive et al., (2007). Furthermore, in Olive et al.'s (2007) study, naturalistic strategies including environmental arrangements were made to ensure that the environment promoted requesting e.g., placing objects in sight but out of reach (Halle et al., 1981). Such environmental arrangement strategies were also utilized in the context of natural routines in Studies 1 and 2. Naturalistic strategies involve the delivery of interventions in interactive contexts which include play and daily routines such as snack time and the use of materials which are of interest to the child (Prizant et al., 2000; Schreibman et al., 2015). The use of such strategies is based on natural opportunities within these routines and following the child's lead wherever possible (Ogletree, 2013). In utilising naturalistic strategies, interventions are therefore child-led (Hart and Risley, 1975). The use of naturalistic strategies in tandem with applied behavioural techniques has the potential to lead to greater generalisation of skills (Logan et al., 2017).

Table 2.2 Studies 1 and 2: Intervention protocol

Target behaviour chain:
Pick up VOCA, reach toward communicative partner with VOCA, and touch hotspot on the VOCA to elicit voice output
1. Communication partner provides a communication opportunity and expectantly waits for the child to initiate request using informal gestures
2. Physical promoter uses full physical prompt to achieve the target behaviour chain. Communication partner uses 2 open handed prompt Child is fully physically supported to request the reinforcer by touching the corresponding hotspot on the VOCA.
3. Physical prompter fades full physical prompting to a partial physical prompt to support the child to pick up VOCA, and reach with VOCA. Communication partner uses a 2 open handed prompt gesture Child independently touches corresponding hotspot for the desired reinforcer to elicit voice output.
4. Physical prompter uses a partial physical prompt to support the participant to pick up VOCA. Communication partner uses a 2 open handed prompt gesture Child independently reaches with the VOCA and touches the hotspot of the desired reinforcer to elicit voice output.
5. Physical prompter faded out Communication partner uses 2 open handed prompt gesture Child completes target behaviour chain independently but requires a visual cue from the communication partner.
6. Physical prompter faded out Communication partner fades out 2 open handed prompt gesture Child completes target behaviour chain fully independently

Data collection

Data was collected on the dependent variable in every session. In both Studies 1 and 2 the dependent variable was defined as independent requesting using the VOCA. Direct systematic observational recording (DSOR), in which each communication opportunity was viewed as a trial, was the method of recording of data utilised (Ayres and Ledford, 2014). All trial data was then converted to a percentage in order to obtain a measure of accuracy (Ayres and Ledford, 2014). Percentage data allowed the researcher to track the child's progress as it was possible to calculate the percentage of trials in which the child spontaneously requested using the VOCA from the total number of trials. The overall

performance of each participant could then be summarised in a graph and in a table for data analysis (Ayres and Ledford, 2014).

DSOR involved the communication partner collecting data about all responses on a data collection form specifically designed for the studies (Appendix 4). Ayres and Ledford (2014) note that the primary data collector is often the person who is implementing the intervention and that this could also lead to bias. To minimise this possibility, a second observer was also present for some sessions to collect inter-observer agreement data (IOA data) and this is described in greater detail below (see Reliability).

Data analysis

As the traditional method of analysis in the SCED is the use of visual inspection of the data patterns which are usually graphed, all data that was collected was plotted on a line graph (Lane and Gast, 2014; Kratochwill and Levin, 2015). Each participant's performance for a single session was plotted as a single point on the graph (Lane and Gast, 2014). According to Spriggs et al. (2018), in SCED research graphic displays such as line graphs are typically utilised for two purposes: firstly, to organise the data from the data collection process. Secondly, constructing graphs allows the reader to analyse the relationship between the independent and dependent variable. This then allows the reader to determine if the intervention has had an effect on the participant's behaviour.

The data plotted in the graph was visually analysed for trend, level, and stability which is the most frequently utilised method of data analysis for SCEDs (Gast and Spriggs, 2014; Lane and Gast, 2014). Trend has been defined as the direction which the data is progressing in and also refers to the steepness of the data path (Gast and Spriggs, 2014). Level refers to the mean score of data within a phase (Kratochwill et al., 2010). According to Wolery and Harris (1982), stability, the final element of the visual analysis refers to the similarity of scores within a given phase (also referred to as a condition) in the SCED e.g., baseline phase,

intervention phase etc. Visual analysis was carried out within a phase and between adjacent phases in order to make comparisons and therefore to determine if there was a functional relationship between the dependent and independent variables (Gast and Spriggs, 2014). The procedures which describe how to visually analyse data provided by Gast and Spriggs (2014) were followed. Supplementary calculations for each participant can be found in Appendix 5.

As an AATD was embedded in the basic MPD design a comparison of the two treatments: VSD and grid display was possible. Supplemental efficiency data were therefore also calculated and presented in a tabular format in the results section of each study. The data were analysed for each participant for each treatment and this was then summed for all participants in each study (Wolery et al., 2014). This enabled the researcher to make judgements about whether one treatment (VSD or grid display) was more superior to the other (Wolery et al., 2014).

It has been suggested that effect size metrics should be utilised as a support to the visual inspection of the graphic display in order to establish that there is a functional relationship between the intervention and the behaviour which is being studied (Parker et al., 2009; Lenz, 2013). While there is agreement on how effect sizes are expressed for group designs, the field of SCEDs is much less developed and there are no agreed upon standards for methods or standards for effect size estimation (Kratochwill et al., 2010). Wolery (2013) specifically states that none of the effect size metrics are satisfactory.

Several methods of analysing SCEDs have been proposed which are either parametric or non-parametric and serve to generate an effect size (Chen et al., 2016). Parker and Vannest (2012) state that they are more often used in practice as they analyse the overlap of data points across phases. This is contrast to parametric effect size metrics which utilise data from the entire design to form an omnibus effect which then forms an effect size metric using statistical models (Parker and Vannest, 2012). It has been suggested that the use of non-parametric

effect size metrics are advocated for due to their compatibility with the logic of visual analysis prevalent in SCEDs as well as the likelihood of generating more meaningful results (Parker & Vannest, 2012). Examples of non-parametric effect size measures include percentage of non-overlapping data (PND; Scruggs et al., 1987), improvement rate difference (IRD; Parker et al., 2009), and Tau-U (Parker et al. 2011) although it is stated that each of these measures has its own flaws (Kratochwill et al., 2010).

Specifically, in relation to the calculation of PND as an outcome metric, it has also been suggested that it should be used with caution due its failure to account for improving trend lines in baseline and overemphasis on the most extreme point in baseline (Parker et al., 2009). Within AAC studies, however, PND has been utilised to calculate effect sizes e.g., Finke et al. (2017). In their chapter on visual analysis of graphic data, Gast and Spriggs (2014) state that PND data should be discussed along with other calculations and PND measures are therefore utilised in the present research.

PND scores can range from 0% to 100%. Specifically, as suggested by Scruggs et al. (1986), PND scores below 50% reflect an intervention which is considered to be either unreliable or ineffective. Scores between 50% and 70% are of questionable effectiveness. When a PND score is between 70% and 90% the intervention is considered to be fairly effective, while a score of over 90% is considered highly effective.

Reliability

Within the context of the SCED, reliability is considered to be a fundamental issue (Gast, 2014b). Reliability refers to the consistency of a treatment and references three issues: reliability of effect, reliability of measurement, and reliability of implementation of procedures (Gast, 2014b).

Reliability of effect refers to confidence that the outcomes of the intervention would be the same if the SCED were repeated with another similar group of participants (Gast, 2014b). This was addressed by systematically replicating the SCED in Study 2, and to a certain extent in Study 4 (discussed below, section 2.6). Reliability also can refer to measurement which refers to accuracy of the data (Gast, 2014b). To address the possibility that there might be errors in the data collection, a second person collected data on the same requesting behaviour. This is referred to as inter-observer agreement and is a comparison of the data collected from both researchers. Finally, reliability can also refer to the degree which the procedures for the SCED were implemented and is referred to as procedural fidelity (Gast, 2014b). This ensures that the independent variable (the treatment protocol) is responsible for the changes in requesting behaviour (Vollmer et al., 2008). Procedural fidelity measures are important as they lend increased confidence to the findings (Gast, 2014b). In Studies 1 and 2 procedural fidelity was measured in a minimum of 30% of the sessions by a speech and language therapist who was trained to do this before the SCED was implemented. Data sheets designed for procedural fidelity can be found in Appendix 6.

Social validity

In Study 2, social validity was assessed through a questionnaire which was given to parents to fill out after the study sessions were completed (see Appendix 7). This process also referred to as subjective evaluation (Schlosser, 2003d), solicits the opinions of those who are in a special relationship to the participants, in this case as parents. This is important because, methods and outcomes which are socially valid in addition to valid results from the SCED itself are more likely to be adopted by stakeholders (Schlosser, 2003d).

The social validity questionnaire included both closed and open ended questions. Closed questions were analysed using descriptive statistics. As some of the questions in the questionnaire were open-ended, however, Study 2 also includes a qualitative strand and is therefore considered to be a mixed methods study.

Richards (2018) states that the use of qualitative procedures within SCEDS have become increasingly popular. Study 2 was designed so that the results of the SCED and that of the social validity questionnaire are connected (Creswell and Plano Clark, 2018). Reflexive thematic analysis which is a more typical method of analysis in the area of qualitative research was therefore also utilised to analyse the results (Braun et al., 2019). The results of the social validity questionnaire were combined with the SCED results at the discussion stage.

2.7 Study 3: Qualitative study

Qualitative research is particularly appropriate where the researcher wishes to explore and gain an in-depth understanding of the experience of a particular individual on a specific clinical issue (Greenhalgh and Taylor, 1997a; Magnusson and Marecek, 2015). Flick (2018) states that it is appropriate to follow quantitative with qualitative research in order to answer a research question in different phases of the research process. In doing so, the data gained from the qualitative study can be utilised to complement that from quantitative studies thus providing a broader picture of the issue under study whilst also being useful in its own right (Flick, 2018).

The design of Study 3 was an interview in which the OT who was involved in providing the interventions in Study 1 and Study 2 was interviewed. This design was selected as it allowed the researcher to explore potential variables which might have an impact on the participants' learning of the VOCA to request in Studies 1 and 2 (Creswell, 2014). Furthermore, the qualitative study allowed the researcher to generate hypotheses which could be further explored in Study 4 (Sullivan and Sargeant, 2011).

Maxwell's (2013) model for research design was used as a tool to conceptually map the qualitative design used in this study. In drawing on this model as inspiration for the study design, the researcher acknowledges that qualitative study designs are not necessarily a linear process. Maxwell (2013) identifies five

components in his model of qualitative research design: the goals, conceptual framework, research questions, methods, and validity. The goals refer to the reasons for carrying out the research. The conceptual framework includes the knowledge and beliefs as well as the personal experiences of the researcher. The research questions are the questions which capture what it is the researcher wishes to learn about. Methods refers to four components including the relationship between the researcher and participant, the selection of participants, settings, time and place for gathering data, the methods of data collection; and finally the methods of data analysis. The fifth component of Maxwell's model refers to validity which the author states is concerned with threats to the design and how these might be countered. A validity threat is therefore an alternative explanation, interpretation, or conclusion to the hypothesis proposed by the researcher.

At this point, it is important to acknowledge that some researchers e.g., Agar (1986) have stated that the use of the terms 'validity' and 'reliability' do not fit the details of qualitative research as they are concepts rooted in quantitative research (Krefting, 1991). The term 'trustworthiness' has therefore been proposed in order to ensure that their definitions fit in with the philosophical viewpoint of qualitative research (Lincoln and Guba, 1985). Guba's (1981) model of trustworthiness identifies four constructs by which rigor can be assessed without sacrificing the relevance of qualitative research. These include credibility, transferability, dependability, and confirmability. Credibility refers to the truth of participant's views and the researcher's interpretation of them (Polit and Beck, 2014). Furthermore, credibility involves ensuring that it is the human participant that is at the centre of the research and to a certain extent this corresponds with internal validity in quantitative research (Sandelowski, 1993). Qualitative research is credible when the research presents an accurate interpretation or description of human experience which is recognised by the participant (Sandelowski, 1986). Transferability refers to the applicability of the findings to other situations outside of the study context (Guba, 1981). As variability is expected in qualitative

research, the term dependability is utilised to refer to variability that can be attributed to identified sources (Guba, 1981). Finally, confirmability refers to neutrality in the data (not researcher) which is achieved when credibility, transferability and dependability are established (Lincoln and Guba, 1985). A fifth criterion, authenticity, has since been added to Guba's (1981) initial model by Guba and Lincoln (1994). This refers to the ability and extent to which the researcher expresses the feelings and emotions of the participant (Polit and Beck, 2014). In view of the importance of making a distinction between quantitative and qualitative research philosophies, the term trustworthiness is utilised in this thesis in preference to Maxwell's (2013) term validity.

Referring back to Maxwell's (2013) qualitative design model, it is noted that the components revolve around the research question as can be seen in Figure 2.5, thus the research question directly connects to the other four components while simultaneously being the most influenced by these. For this reason, Maxwell (2013) refers to the model as being 'interactive', meaning that while there is a definite structure, the components are interconnected and flexible within the structure.

Maxwell's model can be divided into two triangles which are linked by the central research question. The upper triangle which consists of the research question, goals, and conceptual framework is considered to be more conceptual. The research question is linked to the goals of the study which in turn, is to an extent, grounded in existing theory and research, the researcher's own clinical experience, and the previous quantitative study results. Additionally, it is the conceptual framework which informs decisions about what theory and current knowledge is relevant to the study.

The lower triangle can be considered to be the more operational half of the design and is similarly integrated. In this triangle, the research question is linked to the methods used to answer the research question whilst dealing with threats to

validity to these answers. The research question must consider the feasibility of methods to answer the questions and strategies for ensuring trustworthiness.

The components of this conceptual model will be discussed in turn beginning with the goals of Study 3, followed by the conceptual framework and then the research questions. This is because the goals of the study are primary and together with the conceptual framework inform the research question. The methods used to answer this question and the analysis of the data generated will then be described. Finally, the methods and analyses will be discussed in terms of trustworthiness (Figure 2.6)

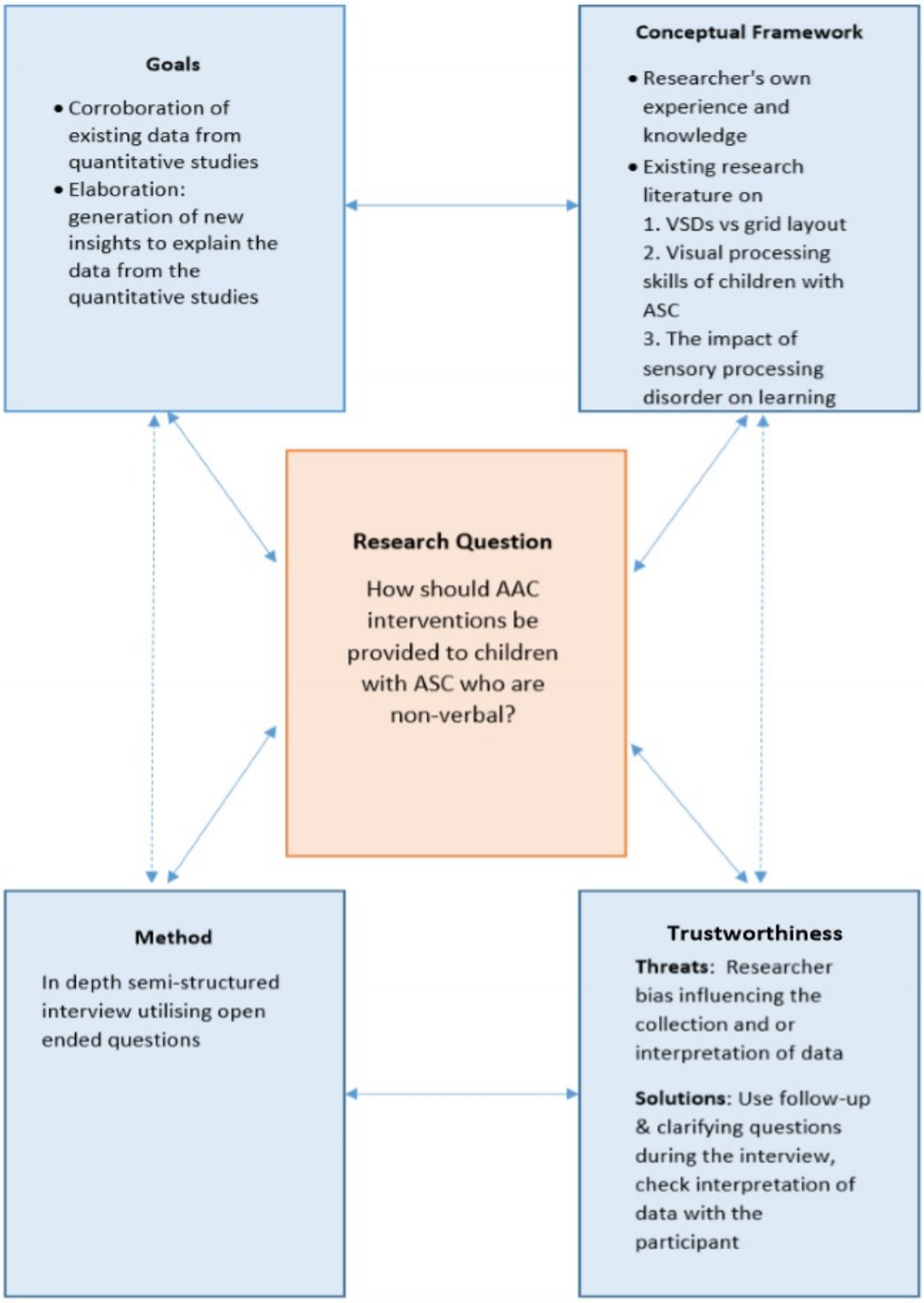

Figure 2.5 Study 3: Qualitative study design (adapted from Maxwell (2013)

. *Goals.* The study was conceived directly after the second quantitative study was completed with two main purposes. The first purpose was to provide corroboration of the results of Studies 1 and 2. Corroboration is defined as having the purpose of confirming of results to support previous conclusions or contradicting of these results (Rossman and Wilson, 1985; Flick, 2018). In this study, corroboration was applied in order to seek convergence between the results from the quantitative studies and the data set from the qualitative study. The second purpose of the qualitative study was to elaborate on data provided by Studies 1 and 2. Elaboration is when data from one design is used to elaborate on another: in this case the data from Study 3 was then used to contribute to the generation of new theories which could then be tested and validated in later stages of the overall research project (Rossman and Wilson, 1985; Patton, 1999).

Figure 2.6 Organisation of the description of the elements of Study 3

Conceptual framework. The conceptual framework includes the researcher's own assumptions, beliefs and theories as well as concepts and the relationships between them. This is used to support and inform the research is used as a tentative theory of the issue which is being studied and which can be used to develop realistic research questions, select appropriate methods and identify strategies to increase trustworthiness (Maxwell, 2013).

An important part of the conceptual framework is the philosophical and methodological paradigm which is used to inform the study. Mertens (2014) notes that leaders in the field do not agree on the need to acknowledge an underlying paradigm e.g., Patton (2002) states that this is unnecessary. Schwandt (2000), on the other hand, states that it is inescapable. In this study a constructionist paradigm was adopted. Schwandt (2000) describes this paradigm as one in which the researcher makes an attempt to understand the complex world from the point of view of those who experience it. Mertens (2014) states that the researcher and participant are interlocked because it is an interactive process. Conducting the study from this standpoint allows the interviewer's values to be taken into consideration and acknowledges that the participant data can never be truly independent as reality is co-constructed by the participant and the interviewer. Furthermore, within a constructionist framework, it is the reality or the perception of reality of the participant through language which is used to create meaning and 'reality' within the data (Clarke and Braun, 2014).

Within the conceptual framework it is important to acknowledge the researcher's own clinical and researcher experience, particularly in relation to carrying out the two previous quantitative studies. Maxwell (2013) states that rather than treating this as bias which should be eliminated from the design, it can be seen as a valuable component serving to support the researcher to gain a better understanding of the research issue. Furthermore, the data from the previous quantitative studies are built into the conceptual framework along with existing literature which is critically evaluated by the researcher. Thus, the conceptual

framework is the integration of all of these components and is used to guide the research questions.

Research question. The research question for this study was used to provide focus as it was linked to the goals and the conceptual framework. It also provided a guide to how the question could be answered as it was linked to the methods used and to validity (Maxwell, 2013). The research question for this study was:

> How should AAC interventions be provided to children with a diagnosis of ASC and who are nonverbal?

This was related to the overarching research question which concerned how SLTs can improve clinical outcomes when making decisions for AAC interventions for children with ASC. At this stage of the overall research project, the researcher was specifically interested in the OT's view as she had been involved in the data collection of the previous quantitative studies.

Methods.

Recruitment. The recruitment process was driven by the need to learn more about how SLTs can make decisions which lead to improved outcomes in respect to AAC systems for children who have ASC (overarching research question). As the goal was to learn more about this issue, the priority was to select a meaningful participant (Flick, 2018). Specifically, it was decided that the perspectives of the OT involved in Studies 1 and 2 would be important as she would be able to provide useful information having been previously involved in the delivery of the intervention in the previous studies. A purposive sampling approach was therefore taken (Greenhalgh and Taylor, 1997a). As sampling occurred before data collection and involved one individual who was able to contribute to the research question this is referred to as critical sampling (Creswell, 2014). Patton (2002) states that critical sampling involves making a decision to recruit individuals who are likely to yield the most information whilst having the greatest impact on

knowledge. The OT as a participant fulfilled this criteria while also presenting a unique opportunity: OTs are frequently involved in the area of AAC, but it is less common for them to be involved in AAC interventions for children with ASC thus it was felt that the interview might provide new insights.

Additional ethical considerations in the recruitment process. Hiller and Vears (2016) state that there are benefits when qualitative research projects are undertaken by clinicans in the role of the researcher. These can include less time being spent in establishing rapport especially when the potential participant is previously known to the researcher as was the case in this study. Specific ethical issues may, however, arise when colleagues are interviewed (McEvoy, 2001). It is possible that this existing relationship could interfere with the participant's ability to give free consent to being interviewed as they may feel an obligation to participate. McEvoy (2001) notes that this is more likely to happen when there is an existing power differential between the researcher and colleague. This was not the case in this study, however, as both researchers were in the position of Team Lead for their respective professions: SLT and OT within the ACTU team.

Site. A clinic room within ACTU was chosen for the data collection as this was the OT's place of work thus it was more accessible and the interview could be scheduled for a time that suited the OT.

Data collection approach. A one-to-one semi-structured interview was identified as the most appropriate data collection process because there was only one potential participant. In this type of interview, the researcher asks questions and records data from only one participant at one time (Creswell, 2014). A decision was made to audiotape the interview on participant consent so that the researcher was free to focus on the participant during the interview. The use of a topic guide (Appendix 8) constructed by the researcher provided some structure but still allowed the researcher to ask other questions in response to the participant's remarks (Clissett, 2008).

Data analysis. Reflexive thematic analysis was used to analyse the data as it can be applied across a range of theoretical and epistemological paradigms including a constructionist approach (Braun and Clarke, 2006). Thematic analysis is a method for identifying, analysing and reporting patterns (themes) within a data set (Braun and Clarke, 2006). Thematic analysis was chosen specifically because it is a flexible approach which can be used to answer research questions involving perspectives as well as practices, behaviours and experiences all of which were relevant to the research question for Study 3 (Clarke and Braun, 2014). Furthermore, this approach is useful for data generated from face to face interviews and can be used with a smaller data set (Clarke and Braun, 2014).

The main goal of a thematic analysis is to identify the predominant themes in the data set (Attride-Stirling, 2001). This involves searching across a data set to find repeated patterns of meaning (Braun and Clarke, 2006). The use of thematic analysis, which is a flexible approach, allows the researcher to analyse data from an individual as opposed to a group of individuals (Braun and Clarke, 2006).

Specifically, an inductive approach was taken to the coding of data thus the analysis was driven by the data itself, a bottom up approach (Braun and Clarke, 2013). In doing so, the researcher's analytic preconceptions are limited as much as possible, thus there was no pre-existing coding frame (Braun and Clarke, 2006). As the researcher takes an active role in identifying, selecting and reporting on themes it is, however, impossible to be purely inductive as the researcher brings her own experiences to the data during the analysis and this is consistent with a constructionist approach (Braun and Clarke, 2006).

Trustworthiness. As discussed above, in order to ensure quality in qualitative research the concept of trustworthiness is utilised (Cope, 2014). Maxwell (2013) states that it is important to ensure credibility, and defines this as how correct the description, conclusions made are, or interpretation of the data is. To achieve

credibility, two broad areas which must be considered within qualitative studies include researcher bias and reactivity (Padgett, 2016).

Bias is considered to be any influence which provides distortion to the results of a study (Polit and Beck, 2014). Researcher bias is difficult to eliminate and Galdas (2017) states that it is erroneous to consider trying to do this as the researcher is an integral part of the process and the final conclusions made. Instead, Maxwell (2013) and Galdas (2017) suggest that it is more important to understand how the researcher's values and beliefs may have influenced the study outcomes, also referred to as reflexivity (Padgett, 2016). This is consistent with a constructionist paradigm which acknowledges the researcher's influence within the research process. In this study, the researcher had theoretical knowledge as well as knowledge of the data analysis and conclusions of two previous quantitative studies. This may have created bias during the interview process as well as in the interpretation of the interview data. The researcher identified this in the planning process and an attempt to ensure that this did not influence the implementation of this study was made by keeping research notes. The use of reflexivity as a strategy also supports confirmability of the findings (Krefting, 1991).

Reactivity is the influence of the researcher on the individual studied (Maxwell, 2013). During an interview situation, the respondent's answers are always influenced by the researcher and this is unavoidable yet according to Maxwell (2013) trying to minimise this is not meaningful. Similar to bias, it is suggested that it is more important to understand how the researcher may influence the participant's responses. In the scenario within the study, the researcher was a colleague of eight years and this may have had an impact on the participant's responses.

Flick (2018) suggests that respondent authentication is one way to enhance credibility and refers to this as communicative validation. Member checks suggested by Creswell (2007) and Padgett (2016) refer to a process whereby

feedback is solicited by the participants on the data and also the conclusions drawn. In this study, the participant was asked to read a transcript of the dialogue in which she participated. The main goal of this was to check that the participant considered that the words match what they intended to say (Shenton, 2004). Furthermore, the participant was also asked to verify the researcher's emerging theories and inferences made from the data.

A second strategy to enhance credibility was the use of an open ended script during the interview process (Maxwell, 2013). This can minimise researcher bias due to reactivity within the interview situation. This also enables the collection of rich data through detailed transcription of the audio recording which provides a detailed grounding for conclusions reached. Furthermore, the use of rich data facilitates judgements of whether the conclusions reached are transferable to other contexts (Creswell, 2007). Transferability is also supported by providing dense background information about the participant and the research context and setting. This can then support others to assess how transferable the findings are (Krefting, 1991).

In order to ensure dependability, an exact description of the methods for data gathering, analysis, and interpretation are provided (Krefting, 1991). Furthermore, coding-recoding was conducted with four weeks in between to increase dependability (Krefting, 1991).

2.8 Study 4: Mixed Methods Study

Study 4 was a mixed methods research study and therefore designed at the outset to include both quantitative and qualitative research methods (Glogowska, 2015). Such methods are particularly useful to build up a more comprehensive picture, thus allowing the phenomena under investigation, in this case teaching children with ASC to learn to use a VOCA for requesting, to be explained in greater depth (O'Cathain et al., 2007). Specifically, Pope and Mays (1995) point out that the provision of health interventions are complex and may also include a set of

questions focusing on human interaction which need answering. The authors state that such questions require qualitative research methods. As objectives specifically relating to how the clinician interacts with the child during intervention formed part of the objectives of this study, a qualitative design was required, but in order to answer this question a quantitative study was also necessary, thus a mixed methods design was utilised. In doing so, it was possible for the mixed methods design to provide the most complete, balanced and useful research results (Johnson et al., 2007).

A pragmatist worldview was taken as the overarching philosophy for Study 4 (Teddlie and Tashakkori, 2003). In such a philosophical orientation, the focus is on the consequences of the research, and therefore focussed towards real-world practice (Creswell and Plano Clark, 2018). Taking such a stance allows the researcher to use multiple methods of data collection in order to provide answers to the research questions. For Study 4, therefore, the researcher was able to combine both deductive and inductive thinking through the use of both quantitative and qualitative data (Creswell, 2013). A pragmatist orientation to research advocates for the use of mixed methods in research acknowledging that the researcher plays an important role in the interpretation of results (Tashakkori and Teddlie, 2010).

The selection of the specific mixed methods design for Study 4 was based on the design which best matched the research problem, and the reasons for mixing data. The overall study design was a mixed methods intervention design. In such a design, both quantitative and qualitative data are collected in the context of the intervention (Creswell and Plano Clark, 2018). In Study 4, the collection of qualitative data took place after the intervention sessions and this is therefore referred to as an explanatory sequential intervention study (Figure 2.7; Creswell and Plano Clark, 2018). The sequence of the quantitative design followed by the qualitative strand enhanced the overall design by providing the researcher with data which could allow the researcher to provide further explanations of the

results from the quantitative study (Newman et al., 2003). Specifically, this allowed the researcher to explore the contexts within which the quantitative design was carried out and to assess how these might have influenced the outcomes (Creswell et al., 2009). This design was particularly suited to the research questions because the researcher wished to understand not just whether a treatment worked but also how it worked (Creswell and Plano Clark, 2018).

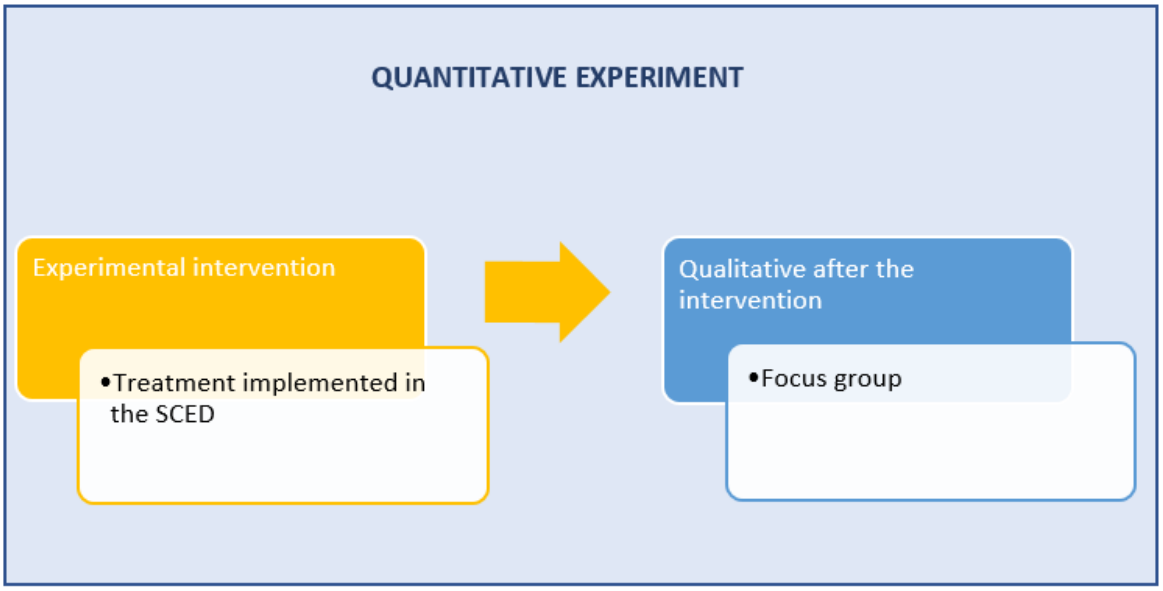

Figure 2.7 Study 4: Overview of the sequence of mixed methods used in study

Creswell and Plano Clark (2018) state that in this design, the quantitative data is viewed as the primary source of information, and the qualitative data is seen as supplemental. The authors also state that this does not mean that the qualitative approach is valued less, and that in response to this concern, high quality qualitative research methods should be utilised. Howe (2004), has raised concerns about limiting qualitative data to a subservient role in such mixed methods research designs. Plano Clark et al. (2013) state that it is necessary to maintain the integrity of the quantitative design (in this case the quantitative portions of the SCED) as a priority in order to ensure that the results are valid. Hall and Howard

(2008), however, state that an equal commitment to both the qualitative and quantitative elements of a mixed methods research design is central to the process. In view of this, and the importance of the qualitative data from Study 4, the researcher made a decision to consider both strands as equal.

In this study, the researcher was interested primarily in how AAC specialist clinicians communicate with children with ASC during AAC interventions and how this impacts outcomes. The qualitative strand, therefore, was a focus group of AAC clinicians which provided the data on AAC specialist clinicians' interactions with the children. The provision of intervention to the children with ASC within the SCED study which also served to provide further data on how sensory processing difficulties may impact the outcomes of AAC interventions served as the quantitative strand. Due to the addition of three open ended questions which were part of the assessment of social validity within the SCED, qualitative analysis methods were also utilised as part of the SCED and this strand is therefore referred to as the SCED strand.

The questions for Study 4 were as follows:

1. How does severity of sensory processing difficulty impact on learning to use a VOCA to request?
2. How do discrete sensory processing patterns impact on learning to request using a VOCA?
3. What are the focus group AAC clinicians' perspectives of how AAC specialist clinicians communicate during the provision of AAC interventions to children with a diagnosis of ASC and co-existing sensory processing difficulty?
4. In what way do the focus group data, reporting AAC clinicians' perspectives of how AAC specialist clinicians communicate during AAC interventions, help to explain the quantitative results of the SCED implemented to teach children with ASC and sensory processing difficulty to learn to request with a VOCA?

A detailed flowchart of how the two strands were implemented can be viewed in Figure 2.8. Merging of the two data sets (also referred to as mixing) takes place when the two data sets are brought together (Creswell and Plano Clark, 2011). Mixing of the two sets of data generated in this study took place during the interpretation (discussion phase), therefore taking place after the two sets of data had been collected and analysed. Each strand of the mixed methods design is discussed below. The discussion begins with the SCED strand as Study 4 commenced with this strand.

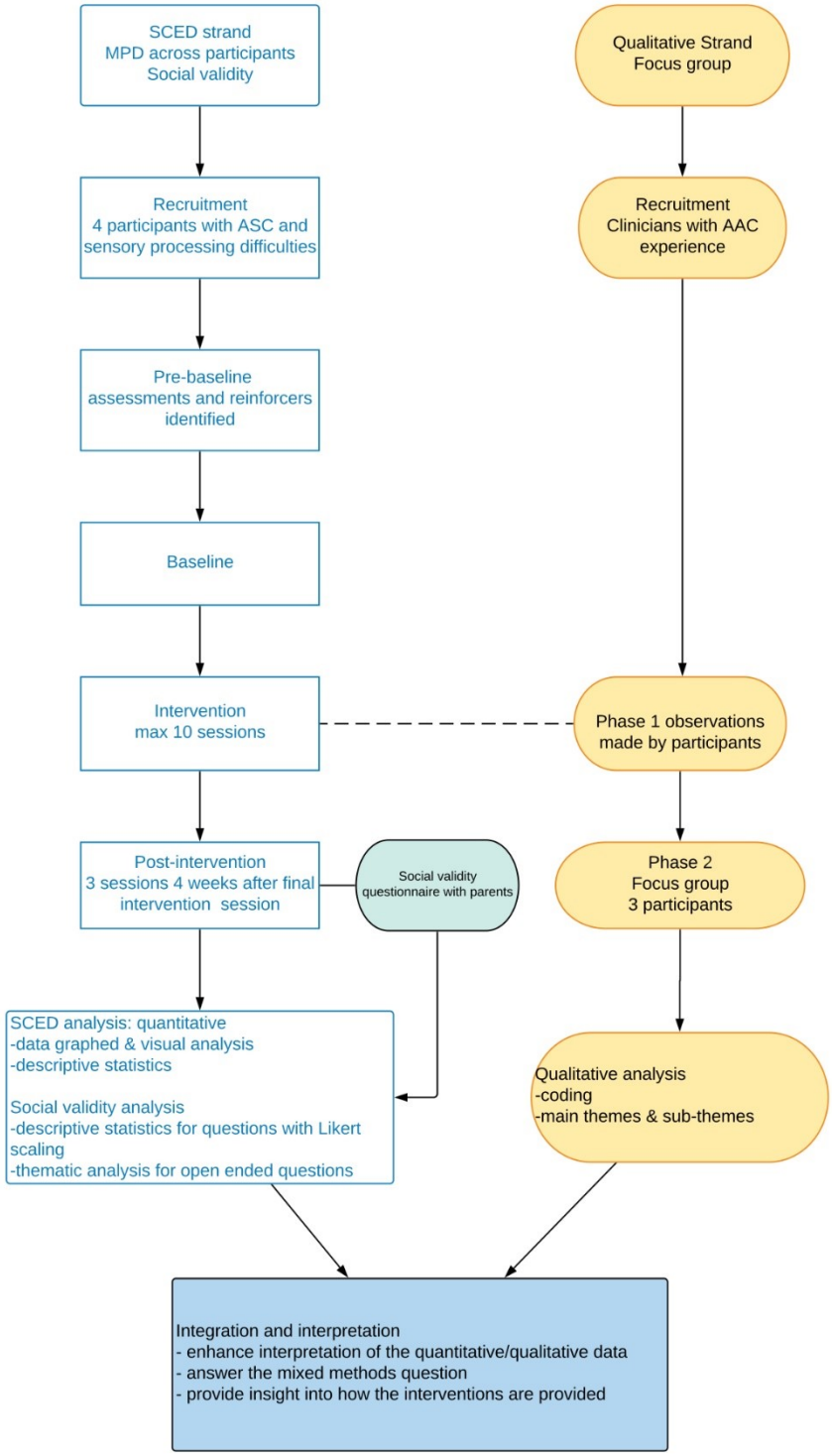

Figure 2.8 Study 4 design

2.8.1 SCED strand

The SCED strand was predominantly a quantitative strand which was planned as a systematic replication of the studies described in 2.6 above. This study was designed to answer research questions 1 and 2 (see above). The data from this study also served to partly answer research question 4 which was the mixed methods question for Study 4. The recruitment of a further four participants with ASC and co-existing sensory processing difficulties allowed the researcher to further investigate how different sensory processing patterns might impact on learning to use the VOCA to request.

The main adaptation from Studies 1 and 2 which was made was that Study 4 was a solely a MPD and therefore not combined with an AATD. Study 4 was carried out by the same SLT and OT who provided the interventions in Study 1 and 2. Given the results of the previous three studies it was decided only to teach the participants to request using the grid display. As only one intervention was provided there was a post-intervention phase four weeks after the final intervention session which served as a maintenance phase. With the use of the MPD, confidence in the experimental findings rests solely on inter-subject replication, i.e. the introduction of the intervention to the four participants. The treatment protocol, data collection and reliability procedures were the same as those described above for Studies 1 and 2. Similar to Study 2, social validity assessment was incorporated in the SCED to ensure high quality research (Manolov et al., 2014). As the assessment included three open ended questions which were designed to allow the respondants to expand on the quantitative questions qualitative analysis in the form of thematic analysis was utilised (Braun and Clark, 2006).

The quantitative portion of the SCED in Study 4 was conducted within a postpositivist worldview. Knowledge which is developed through a postpositivist lens is based on careful observation and measurement (Creswell, 2014). The open-ended questions in the assessment of social validity were analysed taking a

constructionist stance which acknowledges the impact of the researcher's knowledge and experience on the interpretation of the data (Rubin and Rubin, 2011).

2.8.2 Qualitative strand

The qualitative strand of the study was designed as a focus group discussion consisting of clinicians with knowledge in the area of AAC who also worked at ACTU. Focus group methodology was chosen because it can be used to provide data regarding behaviour (Krueger and Casey, 2014). Focus groups can support the researcher to understand how and why the participants feel the way they do about a particular phenomenon (Kitzinger, 1995). Barbour (2013) states that focus groups are valuable tools in understanding decision-making processes and are especially effective in studying professional practices. The particular hallmark of a focus group type methodology is the group interaction which is useful in producing data and insights which might not be so accessible if only individuals were interviewed (Morgan, 1998). Maxwell's (2013) model as presented in Figure 2.6 is also utilised below as a framework to present the focus group methodology.

Goals. The qualitative study was concerned with the researchers' actions and reactions when implementing the treatment in the SCED (Maxwell, 2013). The goal for this study was therefore to explore the process by which the AAC interventions were implemented.

Conceptual framework. The conceptual framework behind the qualitative strand was an amalgamation of the researcher's experiences in Studies 1-3, general clinical experience as well as evidence from the published research literature. The goals for this study together with the conceptual framework were used to support and inform the development of the research question (Maxwell, 2013).

The philosophical and methodological paradigm which was used to inform the qualitative strand was a constructionist one in which the researcher made an

attempt to understand the participants' point of view while acknowledging that the researcher makes an interpretation of this which to a certain extent was impacted by her own experiences (Rubin and Rubin, 2011). A constructionist viewpoint therefore recognises that the participant data is never truly independent as reality is co-constructed by the researcher.

Research question. The research question for this study was linked to the goals and the conceptual framework. The research question for this study was question 3 (section 2.8). The data from the qualitative study was also used to contribute to question 4 which was the mixed methods question. The research question guided the methods used to answer it (Maxwell, 2013).

Methods.

Recruitment. As the goal was to learn more about how AAC specialist clinicians communicate when providing AAC interventions it was decided that participants who also worked in the area of AAC might be able to provide the most insight (Creswell, 2014). Krueger and Casey (2014) refer to the identification of participants as identification of information rich cases. Such cases are those from which the researcher can learn the most about the identified issues which are considered to be important to the purpose of the research (Patton, 2002). For the qualitative study purposeful sampling was therefore used as individuals were intentionally selected (Creswell, 2014). The participants are referred to as focus group AAC clinicians.

Site. A room at the University of Malta was chosen for the data collection as it was decided that a neutral venue might support the participants to discuss the issues more freely than if it was carried out in their place of work.

Data collection approach. A focus group was identified as the most appropriate data collection process. Creswell (2013) defines a focus group interview as a process of collecting data through an interview with a group of

people. Krueger and Casey (2014) state however, that a focus group is a special group in which the participants are selected due to specific characteristics. Focus group interviews present certain advantages including the possibility that greater information can be yielded when interviewees are similar (Creswell, 2013). In this focus group, the participants all had experience of providing AAC interventions to children with ASC and sensory processing difficulties.

Prior to the focus group, the participants were provided with the opportunity to observe real life intervention sessions which were carried out in the quantitative strand of Study 4. They were given directions to observe clinician's communication with the children to whom interventions were provided and to keep a diary which followed the topics listed in Appendix 9. The diary served as a prop which they could refer to during the focus group discussion (Hennink, 2014).

A decision was made to audiotape the interview with participants' consent so that the researcher was free to act as the focus group assistant moderator during the meeting. The moderator of the group was a university lecturer with an occupational therapy background who was chosen because her knowledge of clinical interventions and sensory processing would be useful in moderating the group. An interview guide constructed by the researcher was provided to guide the moderator (Appendix 10).

Data analysis. Thematic analysis as described in section 2.7 was used to analyse the focus group data. Predominant themes were identified using an inductive approach, thus there was no pre-existing coding frame (Braun and Clarke, 2006; Braun and Clarke, 2013; Braun et al., 2019). Codes were grouped into sub-themes and themes and represented visually using a thematic network.

Further applied thematic analysis was carried out using data reduction as described by Guest et al. (2012). Data reduction is a part of qualitative data analysis which serves to sharpen, sort and focus data to support answering

research questions (Huberman and Miles, 1994). The use of data reduction allowed the researcher to focus on specific themes which were identified through the thematic analysis (Guest et al., 2012). All data of specified codes of interest was therefore extracted and a qualitative matrix was created which included the coded text. Guest et al. (2012) state that one advantage of using a data reduction matrix is that it displays the codes and the raw data (the transcribed data) together.

Trustworthiness. Two broad categories of threats that were considered within the focus group study included researcher bias and reactivity (Maxwell, 2013). In this study, the researcher had theoretical knowledge as well as the knowledge of the results of data analysis and conclusions from the three previous studies which may have created bias during the focus group interview process as well as in the interpretation of the interview data. The researcher identified this in the planning process and an attempt to ensure that this did not influence the implementation of this study in a number of ways. Firstly, the researcher chose to be the assistant moderator rather than the moderator of the focus group. Secondly, 25% of the transcribed data was independently coded by another person experienced in coding qualitative data.

As the researcher was a senior work colleague to the participants, a neutral moderator for the focus group and a neutral venue were chosen to minimise the threat of reactivity. This was done to minimise the influence of the researcher on the participants (Maxwell, 2013).

To further ensure trustworthiness, member checking was used as a process. Participants were therefore able to give feedback on the transcribed data and the conclusions drawn (Creswell, 2007). In providing feedback the participants were able to confirm that the words matched what they intended to say (Shenton, 2004). Furthermore, the participants were given the opportunity to verify the researcher's emerging theories and inferences made from the data.

Further strategies to ensure trustworthiness included the use of rich data which was possible by audio taping the interview. The transcript of the focus group interview was verbatim so that conclusions drawn were grounded in detailed data (Maxwell, 2013). This was possible because the participants were known to the researcher who was therefore familiar with their voices. The searching for discrepant evidence when the data reduction matrix was created was a strategy which can also be used to ensure trustworthiness (Maxwell, 2013). Rigorous examination of the data allowed the researcher to assess whether the conclusions being drawn were plausible enough to retain the conclusion

2.8.3 Mixed methods data analysis

Mixing of the two data sets occurred at the level of interpretation, after the implementation of the SCED and qualitative strands, and this enhances the quality of data interpretation (Onwuegbuzie and Teddlie, 2003). The main reason for the mixing was to seek further elaboration on how the intervention was successfully implemented by the clinicians (Greene et al., 1989).

Mixed methods analysis followed the first two steps of a mixed methods seven step data analysis process suggested by (Onwuegbuzie and Teddlie, 2003). Step 1 of this data analysis model is referred to as Data Reduction. In this step, the quantitative data was used to generate descriptive statistics for the SCED. Thematic analysis was used to analyse the qualtitative data from the open ended questions in the social validity assessment and also from the focus group. In Step 2, the creation of data displays was utilised. For the quantitative data this involved the graphing of data from the SCED. Tables were also created to present the descriptive statistics visually. For the qualitative data, thematic networks were created to visually represent the themes generated by the open ended questions in the social validity assessment and the focus group data. Data reduction matrices were also created for the qualitative data from the focus group. No further data analysis was carried out and thus two separate sets of coherent wholes was created (Onwuegbuzie and Teddlie, 2003). Onwuegbuzie and Teddlie

(2003) state that it is not necessary to proceed through all seven steps of the mixed methods data analysis model before passing to the interpretative phase.

This chapter has provided a rationale for the research methods used for each study as well as a description of the methods used and the method of data analysis. Each study will be presented in turn in Chapters 3 to 6. Each chapter will therefore present the research questions, the methods used, the results, and the discussion for each study. Chapter 7, the final chapter in this thesis, is a general discussion in which the results from all four studies are considered to arrive to a final conclusion.

Chapter 3. Study 1

Teaching 4 preschoolers with ASC to request preferred items: A comparison of a visual scene display and grid display using a voice output communication aid in a single case experimental design

3.1 Introduction

Study 1 was designed to investigate which visual display, a visual scene display (VSD) or a grid display is most likely to support children with a diagnosis of autism spectrum condition (ASC) to learn to request. This was in order to partially answer the overarching research question:

> How can SLTs improve outcomes when making decisions for augmentative and alternative communication (AAC) interventions for children with ASC?

The aims of Study 1 were threefold: firstly, to determine if children with ASC could be taught to request with a VSD and grid display using a protocol developed for the study. A second aim was to compare the acquisition of requesting skills using two different visual layouts on an iPad used as a voice output communication aid (VOCA): a VSD and a grid display. The third aim was to investigate whether within child factors including severity of ASC, adaptive functioning, and existing communication levels are related to the acquisition of requesting skills using the two different visual layouts.

Specifically, this study was designed to answer the following sub-questions of the overarching research question:

1. Can four children with a diagnosis ASC and co-existing sensory processing difficulties be taught to request with a VSD and grid display using a protocol developed for the study?
2. How do the two visual display layouts: a VSD or a grid display impact on how minimally verbal children with ASC learn to request using a VOCA?

3. How do the individual characteristics of children with ASC impact learning to use VOCAS?

3.2 Methods

As the overarching methodology for Study 1 is described in detail in Section 2.6, Sections 3.2.1 to 3.2.11 provide greater detail on how the study was implemented.

3.2.1 Participants and recruitment

To recruit participants to the study, the Access to Communication and Technology Unit (ACTU) waiting list was screened. This involved checking referrals to find four participants who met the following inclusion criteria:

a) Diagnosis of ASC from a psychologist independent to the study
b) Under age 6 years
c) Expressively non-verbal or less than 20 words which are used for functional communication.

Exclusion criteria applied were that the participants did not have any auditory/visual impairments that would impact on learning to use the AAC system.

A screening appointment was offered with both a speech and language therapist (SLT) who was the researcher, and a female occupational therapist (OT) who had a clinical role within Study 1 as the intervention protocol developed for the study required two clinicians. The SLT had 21 years of clinical experience of working with children with ASC. The OT had 10 years of paediatric OT experience.

During the screening appointment, it was confirmed that the child was expressively non-verbal or used less than 20 words for functional communication through parental report and informal assessment of the child's expressive communication during the session. This flexibility was necessary as the child might have begun to develop verbal language while waiting for ACTU services.

All four participants met the inclusion criteria and parents were given an information letter in Maltese or English (as suited them) inviting them to voluntarily participate in the study. Once the parents of the participants consented to participation in the study, the assessments listed below were administered to their children by the SLT and/or OT:

1. Autism Diagnostic Observation Scale-2 (ADOS-2): Module 1 (Lord et al., 2012)
2. Vineland Adaptive Behavior Scale-2 (VABS-2; Sparrow et al., 2005)
3. MacArthur-Bates Communication Development Inventory-III (CDI-III): Words and Gestures (Fenson et al., 2007). The Total Gestures section was administered.

During the baseline probes it was apparent that two of the participants had sensory difficulties which might be a potential influencing factor in their progress in the study so The Short Sensory Profile (SSP) was also administered by the resident OT (McIntosh et al., 1999).

A summary of participant characteristics Nathan, David, Jake and Simon (pseudonyms) and the results of assessments carried out are available in Table 3.1.

Table 3.1 Study 1: Summary of participant characteristics

	Participant			
	Nathan	David	Simon	Jake
Age	5;07yrs	4;10yrs	4;09yrs	5;05yrs
Gender	Male	Male	Male	Male
Primary language	English	English	English	English
Secondary language	Maltese	Maltese	n/a	Maltese
ADOS-2 comparison score	8	10	9	7
Level of autism related symptoms	High level of autism-spectrum related symptoms	High level of autism-spectrum related symptoms	High level of autism-spectrum related symptoms	Moderate level of autism- spectrum related symptoms
Total gestures: Age Equivalent (CDI-III: Words and Gestures)	<8mths	8mths	12-13mths	13mths
Description of expressive communication	Requests by pointing. 2 words: 'out', 'home' only when distressed. Will take what he wants without asking	Can say 5 words but these are not used appropriately. Brings adult's hand to desired objects if he cannot take it himself	Requests using 3 words: 'milk', 'yoghurt', 'again'. Labels items although this is not communicative. Will eventually bring an object to an adult if he needs help. Reaches to request	No attempts at words, uses pulling and showing objects. Can point to desired object to request
Prior experience of AAC	PECS introduced 12 months previously. No longer used as was still requiring prompts at Phase I and Nathan refusing to use it	PECS introduced Phase 1 achieved	None	PECS used at school only to request from a choice of 4 food items at snack time
Receptive communication (Vineland-2)	Age Equivalent: 0;10yrs Adaptive level: Low	Age Equivalent: 1;0yrs Adaptive level: Low	Age Equivalent: 1;06yrs Adaptive level: Low	Age Equivalent: 2;11yrs Adaptive level: Moderately Low
Expressive communication (Vineland-2)	Age Equivalent: 1;0yrs Adaptive level: Low	Age Equivalent: 0;3yrs Adaptive level: Low	Age Equivalent: 1;03yrs Adaptive level: Low	Age Equivalent: 0;11yrs Adaptive level: Low
Written communication (Vineland-2)	Age Equivalent: 3;11yrs Adaptive level: Moderate	Age Equivalent: 2;06yrs Adaptive level: Low	Age Equivalent: 4;01yrs Adaptive level: Moderately Low	Age Equivalent: 4;09yrs Adaptive level: Adequate

Communication composite (Vineland-2)	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low
Gross Motor skills (Vineland II)	Age Equivalent: 3;03yrs Adaptive level: Low	Age Equivalent: 3;01yrs Adaptive level: Moderately Low	Age Equivalent: 3;01yrs Adaptive level: Moderately Low	Age Equivalent: 3;03yrs Adaptive level: Moderately Low
Fine Motor skills (Vineland-2)	Age Equivalent: 1;10yrs Adaptive level: Low	Age Equivalent: 2;08yrs Adaptive level: Low	Age Equivalent: 3;04yrs Adaptive level: Moderately Low	Age Equivalent: 2;09yrs Adaptive level: Low
Motor Skills Composite (Vineland-2)	Adaptive level: Low	Adaptive level: Moderately Low	Adaptive level: Moderately Low	Adaptive level: Moderately Low
Daily Living Composite (Vineland-2)	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low
Socialisation composite (Vineland-2)	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low
Adaptive behaviour composite (Vineland-2)	Adaptive level: Low Standard Score: 41	Adaptive level: Low Standard Score: 45	Adaptive level: Low Standard Score: 60	Adaptive level: Low Standard Score: 52
Sensory Profile Classification	Sensory seeker	Sensory seeker	Typical sensory processing	Typical sensory processing
SSP score	124	141	155	155
	Definite difference in 4 areas: 1. Movement sensitivity 2. Underesponsive /Seeks sensation 3. Auditory filtering 4. Low energy/ weak	Definite difference in 2 areas: 1. Underesponsive /Seeks sensation 2. Auditory filtering	All areas within typical performance	All areas within typical performance
	Probable difference in 2 areas: 1. Taste/ Smell sensitivity 2. Visual/Auditory sensitivity	Probable difference in 3 areas: 1. Tactile sensitivity 2. Taste/Smell sensitivity 3. Visual/Auditory Sensitivity		
Educational Placement	Full time Mainstream	Full time mainstream	Full time mainstream	Full time mainstream

3.2.2 Setting and intervention context

All sessions were carried out in the ACTU clinic room (measurements 5.7 x 6.3m^2) as seen in Figure 3.1. Each room was equipped with a child's size table and chair and three adult chairs. One adult chair was for the author of this thesis, the SLT. The second chair was for the OT who carried out the role of prompter. The caregiver chair was for the parent. The observer chair was utilised for the sessions in which an observer was present for procedural fidelity observations (Section 3.2.9). All the equipment not being used for the session was stored out of sight. Each participant was offered sessions in an individual context.

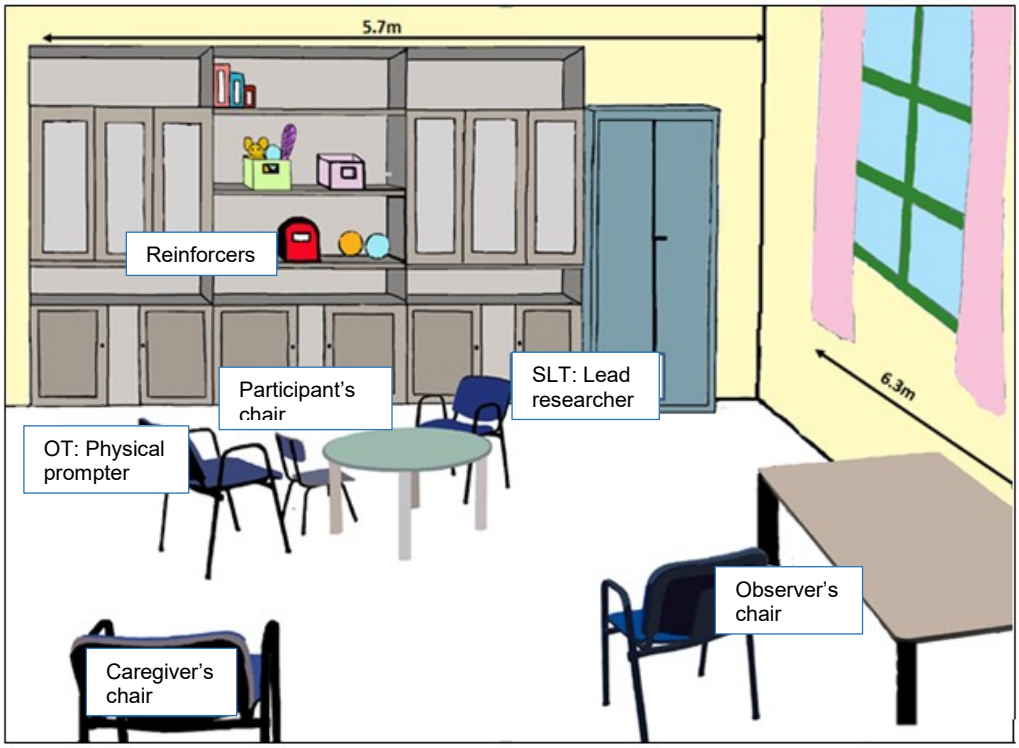

Figure 3.1 Intervention room

3.2.3 Materials

An iPad 4 encased in a Big Grips cover with iOS 9.2.0 was used as a VOCA for all phases of the pilot study. The Scene and Heard® application (app) version 3.0 was installed on the iPad and used for both display conditions. The app could be used for both VSD and grid display conditions, ensuring there were no other

differences between the two conditions apart from the display itself. A further requirement was the capacity to import photographs and make recordings according to the reinforcers identified for each participant in the pre-baseline phase (section 3.2.5). Evidence-based guidelines as suggested by Light et al. (2019b) were utilised in creating the displays for each condition. For the VSD condition, a personalised photograph of the reinforcers on a shelf as they were presented for the sessions was imported into the app (Figure 3.2). The SLT who acted as communication partner was in the photograph as suggested by Wilkinson et al. (2012) as the use of human figures in the VSD serves to attract and maintain interest. The photograph for the VSD condition was programmed with four hotspots which could be activated by touch to emit voice output. The grid display condition was also configured with 4 hotspots in a 2x2 cell layout (Figure 3.3). Photos of the items were programmed to emit a voice recording when the cell was activated. For both displays the voice output for each hotspot was the name of the reinforcer. Voice recordings for both conditions were made by a boy of similar age.

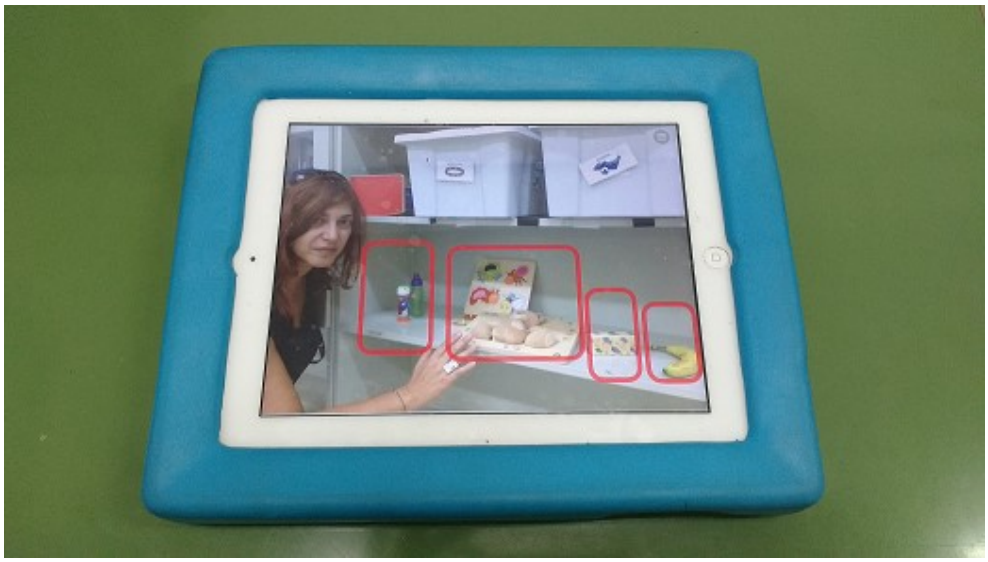

Figure 3.2 Example of the VOCA configured for the VSD condition

Figure 3.3 Example of the VOCA configured for the grid display condition

3.2.4 Study Design

Study 1 (Figure 3.4) was a single case experimental design (SCED) which utilised a multiple probe design (MPD) across participants consisting of pre-baseline, baseline probe, comparison (also referred to as intervention), post-intervention, and follow-up phases (Horner and Baer, 1978). All participants commenced the baseline probe phase on the same day. Baseline probes were carried out once a week until the week prior to the commencement of intervention. In the week prior to commencement each participant then attended for three baseline probe sessions. The MPD supported the sequential introduction of intervention thus the fourth participant remained in baseline for the longest period. During the intervention phase participants were taught to request reinforcers using an iPad as a VOCA with two different visual displays. The commencement of intervention was staggered across participants and therefore introduced one week apart to avoid long periods in baseline in the event that a participant did not make progress with the intervention (Gast et al., 2014). An AATD was embedded in the MPD to allow comparison of the two treatments (Barlow and Hayes, 1979; Wolery et al., 2014).

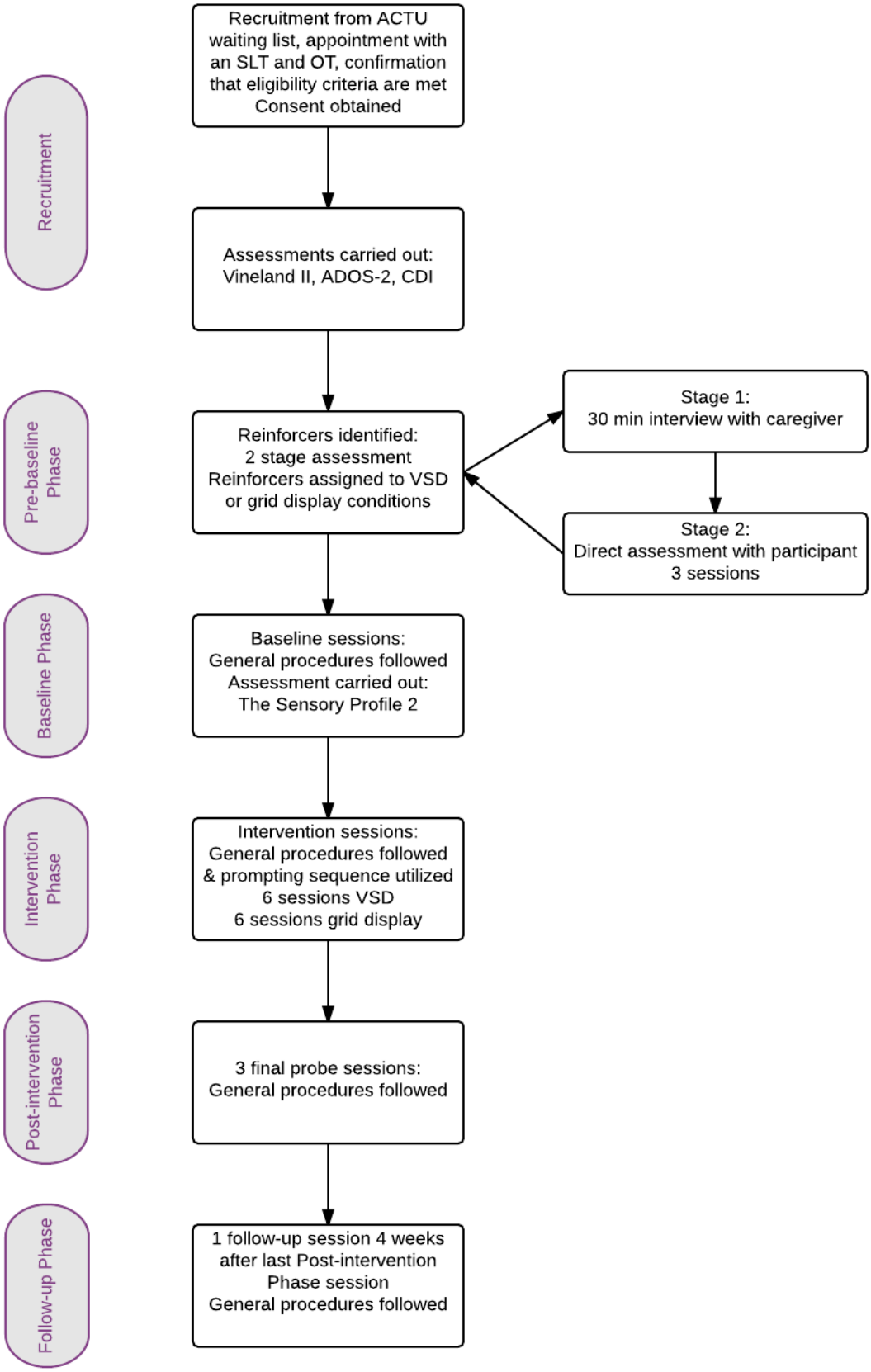

Figure 3.4 Study 1 phases

The treatment conditions compared two types of visual layout: a VSD and a grid display (Figures 3.2 and 3.3). Each participant received 12 sessions of intervention: six in each condition.

3.2.5 Pre-baseline phase: Identification of reinforcers

In order to facilitate success the stimuli utilised reflected the child's interests thus preferred stimuli including food and toys were identified for each participant using a 2 stage reinforcer assessment process during the pre-intervention phase (Kang et al., 2013; Stephenson, 2016). Reinforcers were used for all subsequent phases: the baseline, intervention, post-intervention, and follow-up phases.

Stage 1 of the reinforcer assessment (Appendix 3) was an indirect assessment carried out through a 30 minute caregiver interview adapted from Green et al. (2008). The aim was to identify snacks and toys that the participant appears to enjoy and which were suitable for intervention at ACTU. In stage 2, the stimuli identified in stage 1 were presented to the participants on three separate occasions over 1-2 weeks (Graff and Ciccone, 2002). All stimuli identified were presented group by group: snacks and toys (DeLeon and Iwata, 1996). The participants were encouraged to choose an item from each group. Once an item was chosen the participant was allowed to eat/drink it or play with it for a short time. Choices were then given from the remaining items until there were no items left to choose from. The order of choice was recorded by the researcher.

Snacks and toys were ranked separately using the formula (number of selections/number of offers) x 100%. In accordance with the study design, two sets of four reinforcers were created and each set was randomly allocated to each of the two treatment conditions to ensure that change in requesting behaviour was not influenced by how reinforcing the items were (Table 3.2; Wolery et al., 2014). Simon's two sets of reinforcers were equally reinforcing. For Jake, Nathan, and David the reinforcers were more reinforcing in the VSD condition.

Table 3.2 Study 1: Preferred reinforcers

Participant	***VSD condition***	***Grid display condition***
Nathan	Smoothie 50%, bubbles 100%, puzzle 30%, shape sorter 13.3%	Milk 33.3% , letters 30%, letter box 30%, animals 17.7%
David	Cola 75%, ham 30%, slinky 100%, hand cream 20%	Oreos 75%, juice 17.5%, bubbles 60%, balls 50%
Simon	Sponge 75%, yoghurt 60%, balls 60%, blocks 50%	Banana 75%, crackers 60%, bubbles 60%, puzzles 50%
Jake	Tutti Frutti 100%, letter mats 75%, shape sorter 60%, letter box 27.3%	Plasmon biscotti 50%, money box 75%, animals 60%, bubbles 27.3%

3.2.6 Response definitions and measurement procedures

Spontaneous requesting was the dependent variable. For both display conditions spontaneous requesting was defined as unsolicited picking up of the VOCA, stretching out towards the communication partner with the VOCA, and then touching a cell on the screen to activate the voice output to suggest a request for a reinforcer. Direct systematic observational recording (DSOR) was used to collect data on all requests for reinforcers for the duration of each session in all phases of the study (Ayres and Ledford, 2014). DSOR involved both SLT and OT observing and coding the requesting behaviour as it occurred in the session (Appendix 4). The percentage of independent responding was calculated post-hoc for each session using the formula: independent requests/ (independent requests + prompted requests + incorrect requests) x 100. The mastery criterion was set and considered achieved when the participant spontaneously requested on 80% of trials for two consecutive sessions.

3.2.7 Session schedule

Each participant attended for three sessions of 20 minutes duration on a weekly basis. All sessions were scheduled at the same time of the day and on the same days per week for each participant. Semi-randomisation was used to determine the order of the treatments for each participant with no more than two consecutive sessions of the same treatment. This ensured that the dimension of

alternation of the two treatments would not be lost (Wolery, 2013). Randomisation was also applied to the tiers in the MPD. As the study was a MPD across participants, each tier represented a participant. Two participants commenced with the VSD condition, and two with the grid display condition.

3.2.8 Procedures

3.2.8.1 General procedures

General procedures were maintained across the baseline, comparison (intervention), post-intervention, and follow-up phases. In the waiting room, the participant was shown a photograph of the screen display: VSD or grid display, which was to be used for the forthcoming session. The researcher pointed to the items in the photo while saying "today you can ask for these things using the picture (for the VSD condition)/grid". Each participant had two photographs reflecting the reinforcer sets identified in the reinforcer assessment to support discrimination between the two conditions (Schlosser, 2003c).

The reinforcers identified for the VSD and grid display conditions for each participant were made available on a shelf which was in sight but which could not be physically accessed by the participants. On entering the room, the participant was directed to the items on the shelf and asked "what do you want to do?". The participant was expected to make a selection by pointing, reaching or using the VOCA. If the participant did not make a choice within 10 seconds, two reinforcers were selected by the researcher and offered to the participant to make a choice. If no choice was made within a further 10 seconds one of the reinforcers was replaced with another. This was continued until all four reinforcers were offered. If no selection was made after all four reinforcers were offered the session was terminated. Once a reinforcer was selected, naturalistic strategies including environmental arrangement and waiting were used to create more opportunities for requesting (Halle et al., 1981; Olive et al., 2007). Reinforcers were provided immediately and the name of the requested reinforcer was stated by the communication partner. Participants were able to request as frequently as desired

during a 20 minute period. All requests made by the participant were recorded during the session by the communication partner on data sheets designed for the study (Appendix 4).

3.2.8.2 Baseline probe

The baseline probe was designed to collect data on the participants' current spontaneous requesting skills using the VOCA. The probes provided a baseline against which the effects of the treatment could be measured. This involved a 20 min session which was divided into two 10 min sessions: one for each display condition. The order of the condition was randomly decided for each participant. The VOCA was available on the table during all baseline sessions although the participants were not directed to it or taught how to use it for requesting. All attempts to request reinforcers using pointing, reaching or vocalisations were honoured by the researcher by providing immediate access to the item.

3.2.8.3 Intervention

Each participant attended for six sessions of intervention. The intervention sessions were identical to those in the baseline except that the independent variable was introduced. The independent variable introduced was the use of prompting procedures designed for this study which were implemented to support the child to learn to independently request using the VOCA in both conditions. Table 3.3 displays the prompting sequence utilised to teach the child the requesting behaviour. To ensure requesting of at least two reinforcers per session, the researcher used the phrase "let's tidy up and choose something else" if the child continued to request the same reinforcer for longer than 10 min. If a child continued to play with a reinforcer for more than 30 seconds, a natural cue e.g., "We have more animals" during animal play was used to encourage the child to request again.

Table 3.3 Prompting sequence

Target behaviour chain:
Pick up VOCA, reach toward communicative partner with VOCA, and touch hotspot on the VOCA to elicit voice output

1. Communication partner provides a communication opportunity and expectantly waits for the child to initiate request using informal gestures

2. Physical promoter uses full physical prompt to achieve the target behaviour chain.
   Communication partner uses 2 open handed prompt
   Child is fully physically supported to request the reinforcer by touching the corresponding hotspot on the VOCA.

3. Physical prompter fades full physical prompting to a partial physical prompt to support the child to pick up VOCA, and reach with VOCA.
   Communication partner uses a 2 open handed prompt gesture
   Child independently touches corresponding hotspot for the desired reinforcer to elicit voice output.

4. Physical prompter uses a partial physical prompt to support the participant to pick up VOCA.
   Communication partner uses a 2 open handed prompt gesture
   Child independently reaches with the VOCA and touches the hotspot of the desired reinforcer to elicit voice output.

5. Physical prompter faded out
   Communication partner uses 2 open handed prompt gesture
   Child completes target behaviour chain independently but requires a visual cue from the communication partner.

6. Physical prompter faded out
   Communication partner fades out 2 open handed prompt gesture
   Child completes target behaviour chain fully independently

If the participant requested a different item from the current reinforcer e.g., if the child was playing with a ball, but touched bubbles, a correspondence check was carried out to ensure that the participant was really requesting a new item (Figure 3.5). If there was no correspondence, the communication partner used a procedure referred to as an error correction sequence in which the response which matched the child's preference was demonstrated to the participant (Figure 3.6; Frost and Bondy, 2002). Error correction procedures were utilised in this research to increase the probability of correspondence between the item being requested using the VOCA and the child's response when given the requested item (McGhan and Lerman, 2013).

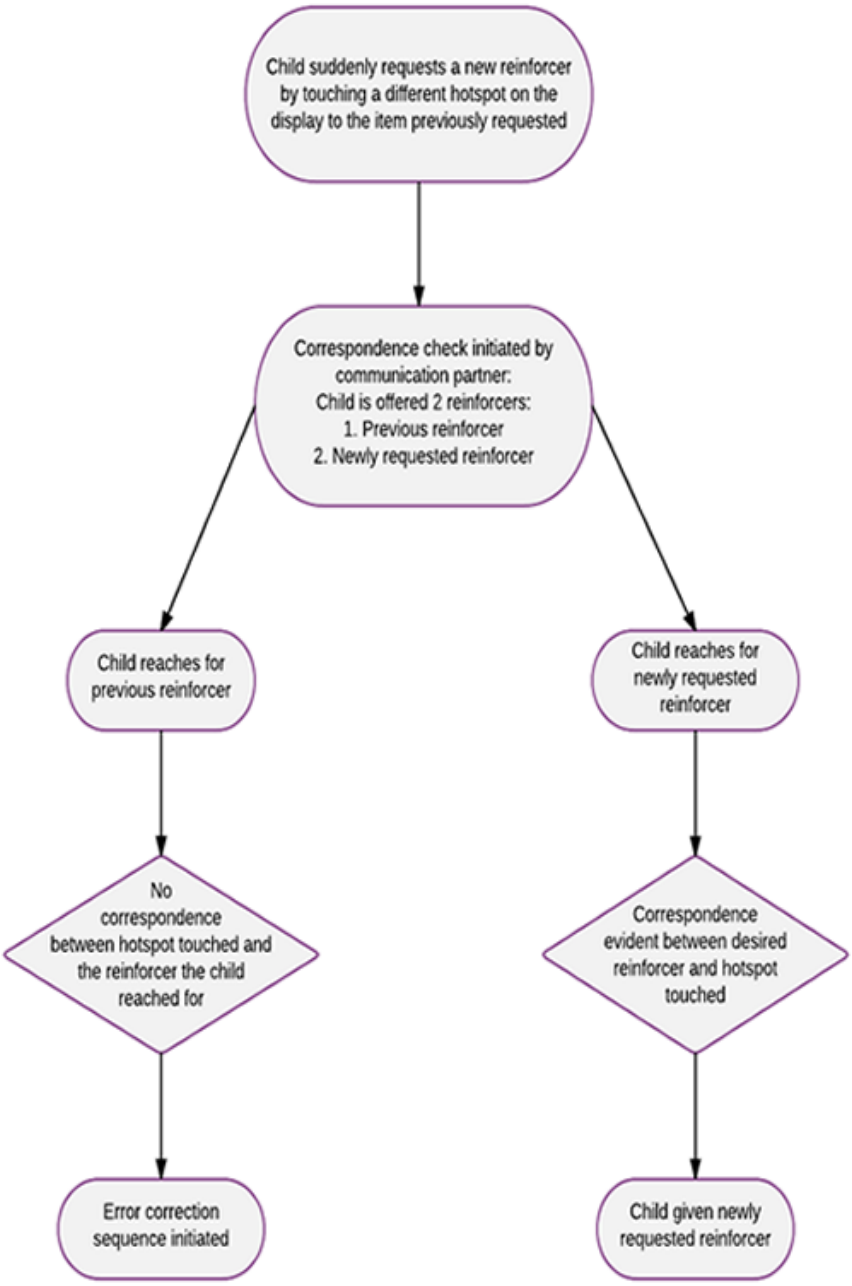

Figure 3.5 Correspondence check procedures

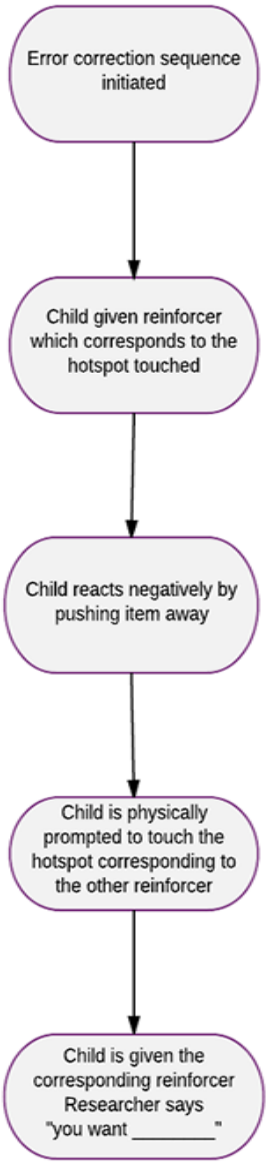

Figure 3.6 Error correction procedure

3.2.8.4 Procedural modifications

All the participants except Nathan made progress during the intervention phase. As Nathan was making minimal progress in both conditions procedural modifications were made to the intervention procedures after session 8. The prompting procedure was altered to commence with 10 consecutive fully physically prompted trials at the start of each session to support Nathan to perform the full behaviour chain. Graduated guidance which involved the use of

the least amount of physical guidance necessary to ensure the Nathan made a correct request was then used in the trials which followed. Nathan's reinforcers were reassessed and one reinforcer (letter) was changed to an iPad in the grid display condition.

3.2.8.5 Post-intervention

Each participant received three sessions in the post-intervention phase which was identical to baseline and therefore no further intervention was provided. Two participants randomly commenced with the VSD condition, the other two with the grid display condition.

3.2.8.6 Follow-up

Maintenance was assessed in one session four weeks after the last post-intervention session using procedures identical to those in the baseline phase. The session commenced with the VSD condition for two participants and with the grid display condition for the remaining two participants.

3.2.9 Procedural fidelity

To assess reliability of the implementation of research procedures, an independent observer who was a SLT collected data for 31% of all sessions (Table 3.4). The observer received training on how to score the checklist before the study commenced. Training included a) discussion of the procedures for each phase, b) modelling how each phase would be implemented, and c) role play. The lead researcher provided training until a mastery criterion of 90% was achieved.

3.2.10 Inter-observer agreement

Live data were collected on the frequency of independent requests and number of prompted trials by the SLT and OT who implemented the interventions. For each session, percentages of agreement between the independent observer and the researcher were calculated using the formula: agreements/ (agreements + disagreements) x 100 (Ayres and Ledford, 2014).

3.2.11 Data analysis

Data analysis included a visual examination of the data for trend, level and stability within and between the VSD and grid display conditions for each participant (Figure 3.7; Lane and Gast, 2014). Data to determine the relative efficiency of each display condition are described in Section 3.3.3. Supplementary calculations are available in Appendix 5.

3.3 Results

3.3.1 Procedural fidelity results

Procedural fidelity results for each phase of the study are displayed in Table 3.4. The overall mean for all four participants was 99%. Ninety-nine percent (range, 95%-100%) procedural fidelity was calculated for Nathan. Ninety-five percent (range, 91%-98%) procedural fidelity was recorded for David, while procedural fidelity was calculated at 97% (range, 92%-100%) for Simon. For Jake, procedural fidelity was calculated as 98% (range, 96%-100%). Calculations of procedural fidelity were made by dividing the number of observed behaviours by the number of planned behaviours multiplied by 100 (Gast, 2014b).

Table 3.4 Study 1: Procedural fidelity results

	Baseline probe	***Intervention***	***Post-intervention***	***Follow-up***
Nathan	100%	98.3%	100%	100%
David	98%	93.3%	98%	96%
Simon	100%	95.3%	98%	100%
Jake	98%	97.3%	99%	100%

3.3.2 Inter-observer agreement results

Inter-observer agreement ranged from 96 to 100% with an overall mean of 99.4% indicating strong agreement. For sessions with Nathan 99.6% (range, 98%-100%), for all sessions with David 99.1% (range, 97%-100%), for all sessions with Simon 99.1% (range, 96%-100%), and for all sessions with Jake it was 99.8% (range, 98%-100%).

3.3.3 Participant results

3.3.3.1 Baseline

The results for the participants was graphed for each participant and a visual analysis of the data carried out to identify if there was a functional relationship between the introduction of the two treatments and requesting behaviour (Figure 3.7). All participants had a stable zero performance in the baseline phase for both display conditions meaning that they did not request independently using the VOCA as defined for the study. Simon demonstrated an interest in the VOCA during the first two baseline sessions by randomly activating the cells to activate the voice output. Jake also showed interest in the VOCA and systematically activated each hotspot in both display conditions in three of the baseline sessions. David showed no interest in the VOCA during the baseline sessions while Nathan unsuccessfully attempted to exit the app on more than one occasion.

3.3.3.2 Intervention overview

Once the intervention was introduced (see 3.2.8.3), three participants demonstrated an immediate increase in the level of independent requesting for both conditions. The fourth participant, Nathan, demonstrated a delayed increase in independent requesting in both conditions.

Efficiency data is presented for individual participants and the overall group in Table 3.5 in order to compare the VSD with the grid display (Wolery et al., 2014). During both intervention and post-intervention phases the mean percentage of requesting as a group was slightly higher in the grid display condition (57.3%) than the VSD condition (55.2%). The mean performance scores for the post-intervention phase were higher than the intervention phase for both conditions. The overall mean remained higher in the grid display (86.7%) compared to the VSD (82.9%).

For Simon and Jake, the number of sessions to criterion was between two and four sessions for both conditions. Nathan and David failed to achieve criterion in

both visual displays although an accelerating trend was evident with the introduction of the intervention (Figure 3.7). As two participants failed to achieve criterion it was not possible to calculate the mean number of sessions to criterion as a group.

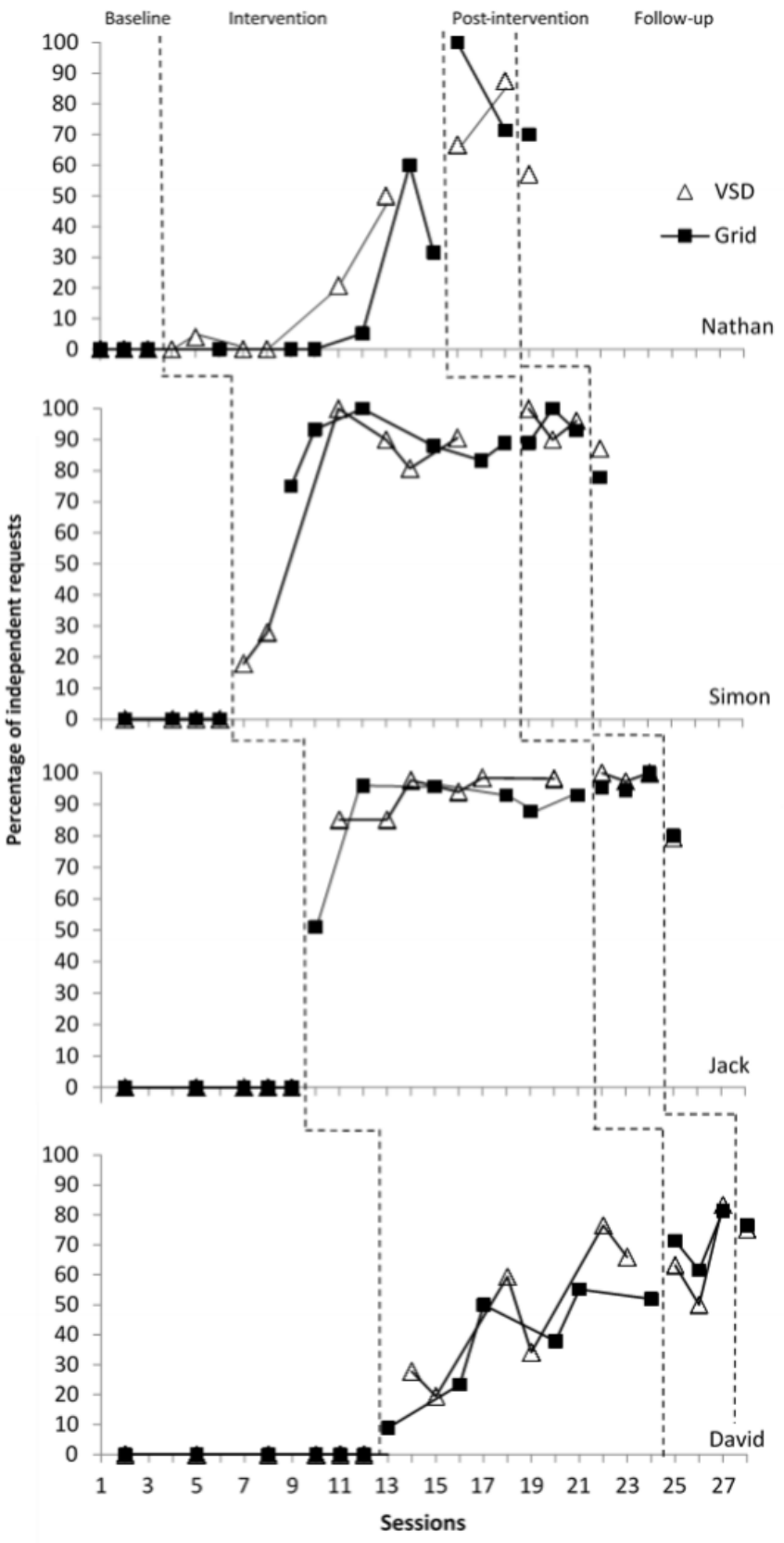

Figure 3.7 Percentage of correct requests for the VSD and grid display conditions

Table 3.5 Study 1: Efficiency data for the VSD and grid display conditions.

	VSD					Grid display				
Participant	**Baseline %**	**Intervention %**	**Post-intervention %**	**Errors to criterion %**	**Sessions to criterion**	**Baseline %**	**Intervention %**	**Post-intervention %**	**Errors to criterion %**	**Sessions to criterion**
Nathan	0	12.5	74.1	87.5	Not achieved	0	16.1	85.7	83.9	Not achieved
Simon	0	67.9	96	32.1	4	0	88.9	92.9	11.3	3
Jake	0	93.1	99.1	6.9	2	0	86.1	96.7	13.9	3
David	0	47.2	65.5	52.8	Not achieved	0	37.9	71.4	62.1	Not achieved
Overall (mean)	0	55.2	82.9	44.8	N/A	0	57.3	86.7	42.8	N/A

Overall, the mean percentage of errors during the intervention phase was slightly higher in the VSD condition. As Nathan and David failed to reach criterion in either display condition, the data in Table 3.5 is the percentage of errors for six sessions of intervention in each display condition. Nathan and Simon demonstrated a higher percentage of errors in the VSD condition. Jake's and David's results, on the other hand, indicate a greater mean percentage of errors in the grid display condition.

PND scores for each participant are displayed in Table 3.6. The PND scores for Simon, Jake, and David all indicated that the intervention was highly effective for both the VSD and grid display conditions. For Nathan, for both conditions, the intervention was considered to be of questionable effectiveness.

Table 3.6 Study 1: PND metrics from baseline to intervention for the VSD and grid display conditions

Child	***VSD***	***Grid display***
Nathan	50%	50%
Simon	100%	100%
Jake	100%	100%
David	100%	100%

In the next sections, each participant's performance in the study is described individually in greater detail.

3.3.3.3 Nathan

Nathan failed to achieve criterion in both display conditions (Figure 3.7). When intervention commenced there was minimal change in independent requesting until session 9, resulting in a delayed increasing trend. Independent requesting using the VOCA began after procedural modifications were made in session 8. Prior to this, Nathan exhibited a variety of sensory seeking behaviours which prevented him from fully completing the behaviour chain to independently

request. This included picking up the VOCA, reaching with it and then pressing on the display with his hands.

Due to sickness, Nathan missed one session in the post-intervention phase. An accelerating trend was evident in the VSD condition while a decelerating trend was observed in the grid display condition. Nathan was able to achieve independent requesting above 80% in one session in the post-intervention phase but for only one reinforcer in each condition. The iPad and smoothie drink were extremely strong reinforcers and Nathan became anxious if asked to choose something else. Independent requesting in the follow-up session was at a lower level and below the range of requesting data evident in the post-intervention phase particularly in the VSD condition.

3.3.3.4 Simon

Simon achieved criterion on his fourth session in the VSD condition and on the third session in the grid display condition (Figure 3.7). The data points overlapped on two occasions. From session 4, Simon began to touch the screen to indicate a request without picking up and reaching with the VOCA. As he touched the display without physically orienting himself or looking at the communication partner, it was decided to continue to expect Simon to fulfil the requesting sequence as defined by the study. A 3 second delay was implemented before the clinician used the open hand prompt to support Simon to understand that he needed to use the full behaviour chain in order to receive the desired item. This appeared effective as the data for the sessions gradually increased again. In four sessions during the intervention phase, Simon wanted to request things not available to him as reinforcers e.g., being pushed on a chair. Due to this, one session was stopped 3 minutes early, in the other three sessions he was persuaded to request the reinforcers programmed on his AAC displays.

In the post-intervention phase, the mean level of requesting in both display conditions was higher than the intervention phase. While Simon's independent

requesting in the follow-up session was lower than the post-intervention phase it remained within criterion for both conditions.

3.3.3.5 Jake

Jake achieved criterion on the second and third sessions in the VSD and grid display conditions respectively. There were two overlap points where the data paths crossed between conditions. Anecdotally, Jake appeared to enjoy using the VOCA to request from his first session. He smiled often and quickly learnt to use the VOCA fluidly. In his final sessions, a small number of requests were coded as incorrect as Jake was very fast to request and mistakenly activated the voice output of adjacent cells. He self-corrected his errors almost immediately.
In the post-intervention phase Jake continued to request within criterion levels in both display conditions. In these sessions, Jake discovered he could exit his communication page within the app and was keen to explore other pages for requesting.

Jake attended for one follow-up session and requesting in both display conditions was lower than in the post-intervention phase but within criterion. Requests coded as incorrect in the grid display condition were due to multi-tapping possibly due to impatience to wait for activation of the voice output. In the VSD condition, errors were made due to activation of adjacent cells which he corrected without being prompted.

3.3.3.6 David

David failed to reach criterion in either of the intervention conditions although an immediate change in baseline requesting was evident when the intervention was introduced (Figure 3.7). A large number of errors in both conditions were due to touching the incorrect cell to request the desired reinforcer. Due to David's sensory seeking behaviours, he would begin to request a desired object but would lose focus as he would be distracted by the need to seek movement. From session 5, David began to pay greater attention to the cell he was touching but engaged

in multiple tapping behaviours resulting in accidental activation of cells adjacent to the desired cell. The verbal prompt 'slow down' was introduced by the researcher when David began to initiate the requesting sequence. This was somewhat effective as an improving trend was evident in both conditions.

In the post-intervention phase, a gradual accelerating trend was evident in both display conditions. Errors in both conditions continued to be due to multiple tapping on the display resulting in activation of adjacent cells. In the final follow-up session the percentage of independent requesting was slightly lower than the last session of the post-intervention phase.

3.4 Discussion: Study 1

The first aim of this study was to determine if the protocol developed for teaching the participants to request with the VOCA would be successful when applied to two visual displays: a VSD and a grid display. Two participants, Simon and Jake met criterion for both conditions in 2-4 sessions with relatively few errors. Nathan and David, on the other hand, failed to reach criterion in either condition. Their data paths, however, exhibited an accelerating trend suggesting that with more sessions of intervention it was possible that they could have met criterion in both visual displays. The teaching protocol was therefore more successful for some participants than others.

A further aim for Study 1 was to compare the use of a VSD and a grid display to learn to request. A comparison of the percentage of errors and number of intervention sessions to criterion was carried out to achieve this (Schlosser, 1999a). Nathan made a similar percentage of errors in both conditions while Simon's percentage of errors was four times higher in the VSD condition. This is interesting because Nathan's reinforcers were more reinforcing in the VSD condition. It could therefore be assumed that this could have supported him to learn to use the VSD with less errors but this did not appear to be the case. David

and Jake's mean percentage of errors were higher in the grid display condition. For these participants, it is possible that the reinforcers which were more reinforcing in the VSD condition supported them to learn to use the VSD with less errors. When taken as a group, the percentage of errors was similar for both conditions suggesting no meaningful difference between the two display conditions. On an individual basis, it appears that participants made a higher number of errors in the condition intervention commenced in. Simon, for instance, made a greater percentage of errors in the VSD condition possibly because his interventions commenced with two sessions in the VSD condition and a greater percentage of errors was typically made in the early stages of intervention for all participants.

It was only possible to compare the number of sessions to criterion for two participants: Jake and Simon, as Nathan and David did not achieve criterion in either of the visual displays. When number of sessions to criterion were examined, Jake required three sessions in the grid display condition and two in the VSD condition. It is possible that Jake required less sessions in the VSD condition because his reinforcers were more reinforcing in the VSD condition, making it more likely that he would learn to use the VSD in less sessions. Simon needed four sessions in the VSD condition and three in the grid display condition. Similar to percentage of errors, the extra session required in the grid and VSD conditions for Jake and Simon respectively appears to be related to the condition intervention commenced. Furthermore, examination of the data paths indicates that in the early sessions the data points were cumulative suggesting that what was learned in one condition appeared to carry over to the other. This happened despite the use of two separate sets of reinforcers for each condition. It would therefore appear that the visual display itself may not have impacted learning to request with the VOCA. This is also supported by the overlap of data paths evident in three of the participants' results: Simon, Jake and David.

It has been stated that heterogeneity within the population of children with ASC means that not one AAC system is likely to be a fit for all children (Schlosser and Wendt, 2008a). The final aim for Study 1 was therefore to investigate within child characteristics which might influence learning to request using the VOCA. All four participants had a diagnosis of ASC, were under the age of 6 years and were nonverbal yet two participants learned to use the VOCA in both conditions relatively fast while the other two failed to meet criterion in both conditions. Differences between their results can be accounted for by examining participant characteristics (Wolery, 2013). This is important as it may provide clinicians with insight on how to make decisions within the population of children who have a diagnosis of ASC and are minimally verbal.

Three of the participants: Nathan, Simon and David were assessed as having a high level of autism related symptoms on the ADOS-2 yet Simon learned to use the VOCA to request in both conditions much faster than Nathan and David. Based on the evidence of this small cohort, it appears that severity of autism may not be a significant factor in how fast a child will learn to use a VOCA for communicative purposes. While severity of autism did not appear to be related to how the children progressed in this study, other child characteristics may be more indicative.

Communication skill levels at the outset of the study appeared to be an indicator of how the participants progressed. Nathan and David who did not reach criterion in either display had the lowest Total Gestures Scores on the CDI-III suggesting they had the lowest levels of early social-communicative skills. It is possible that for them, the early sessions of intervention served to teach them about the process of communication and because they demonstrated low levels of early social-communicative skills a greater percentage of errors was evident during those sessions. It can be hypothesised that because of Nathan and David's lower social-communicative skills at the outset of the study, a greater number of sessions would have been required for them to learn the skill of requesting. This is

in contrast to Simon and Jake, who, on the other hand, presented with higher early social-communicative skills and achieved criterion in both displays during the course of the study. For these two children, the intervention sessions targeting requesting using the VOCA may have served to augment already developed communication skills; thus, less errors were apparent and fewer sessions were required. This is particularly relevant to Jake who already had previous experience of PECS to make choices during snack time. In his case, therefore, there was already pre-existing knowledge of the basics of how to communicate with an AAC system which may have pre-disposed him to learning to use the VOCA.

Apart from lower scores on the CDI-III, Nathan and David also presented with the lowest receptive language scores on the VABS-2. Sievers et al. (2018) conclude that comprehension could be a predictor of response to AAC interventions. Taking this into consideration, it would appear that lower comprehension levels at the outset of intervention should be factored into a clinician's expectations as it may take longer for a child to establish the relationship between the graphic symbol on the display and the real world referent (Romski and Sevcik, 1993). It could be argued that based on previous literature e.g., Light and McNaughton (2012b), the VSD could provide the child with additional contextual clues to reduce the cognitive demands associated with symbol learning but there was no evidence for this in the present study. The findings of Study 1, are, however, similar to those reported by Barton-Hulsey et al. (2017) who conclude that it is unclear if for children without an established receptive language lexicon, such as the children in this study, there is any particular advantage to using a VSD to arrange vocabulary. The two participants who achieved criterion, Simon and Jake, also had higher levels of overall adaptive functioning than Nathan and David suggesting that children with lower levels of adaptive functioning may find it more difficult to learn to use aided AAC. Although the existing literature base does not indicate how adaptive functioning levels might influence learning to use a VOCA, a meta-analysis conducted by Ganz et al. (2011) suggested that overall level of functioning may be a mediating factor in the success of aided AAC. The authors

also hypothesized that children with multiple disabilities are likely to struggle in learning to use AAC as a mode of communication but none the less learning to use AAC is still possible. This results of this study appears to support this as both David and Nathan who also had co-existing sensory processing difficulties exhibited trend paths which indicated positive progress albeit slower than the other participants' progress.

It is possible that the presence of sensory processing difficulties may have impeded learning to use AAC for both David and Nathan. Ayres (1979) states that sensory processing is the process of organising sensory inputs for use and also hypothesised that when there is an impairment in sensory processing this may manifest itself as difficulty with purposeful behaviour. Both Nathan and David presented with sensory seeking patterns which according to Watson et al. (2011) is likely to be associated with social communication symptom severity. Sensory seeking patterns involve more intense focus on stimuli which can then impact on orienting of attention to other stimuli (Patten et al., 2013). This appeared to be particularly relevant to Nathan who was constantly seeking pressure and utilised the VOCA to meet his sensory needs on many occasions. This was also, however, relevant to David as he found it difficult to focus and maintain attention to use the VOCA to request as he attempted to seek movement. Bo et al. (2016) note that effective motor learning relies on accurate sensory feedback thus when a child has sensory processing difficulties this may impact on the child's ability to learn a motor behaviour such as the requesting behaviour which was required in this study. This was particularly evident in Nathan's case and it is therefore suggested that assessment of the child's sensory processing skills prior to AAC interventions could be considered as other interventions may be necessary to target sensory processing as an adjunct to the AAC intervention. It was also possible that the sensory processing difficulties evident in Nathan and David's profiles also contributed to the variability in the results between sessions.

The results of Study 1 have implications for decision-making when introducing a VOCA. From the discussion above, it is suggested that existing communication skills and adaptive functioning levels should be considered when making clinical decisions for the introduction of AAC to children with ASC. The findings of this study also suggest that it is possible that the presence of sensory processing difficulties may also impact on learning to use a VOCA. If so, there are other clinical decisions which need to be made, for example, it may be necessary to consider implementing sensory motor interventions as an adjunct to the AAC intervention. A decision would need to be taken about how such interventions would be provided. This could include decisions about where the intervention might be provided e.g., in a sensory motor room, or in the typical setting that the AAC intervention is provided in, and in what way it would be combined with the AAC intervention. In the present study, sensory processing was assessed in baseline but no interventions were provided to support the sensory processing difficulties experienced by two of the participants. It is possible that had such intervention been provided these participants might have achieved criterion within the number of sessions allocated for each display condition as it has been suggested that sensory processing interventions could be utilised to support learning other skills (Case-Smith et al., 2015). Furthermore, such intervention might have led to decreased variability in the results.

The results of this study suggest that when children have lower levels of adaptive functioning, low levels of communication skills and sensory processing difficulties they are likely to take longer to learn to use a VOCA. Given the literature base which classifies sensory processing difficulties into differing sensory processing patterns, it is also possible that different sensory processing patterns may impact on learning to use a VOCA to request. The study presented no evidence for a difference between learning to communicate with a VSD or a grid display thus the decisions about how vocabulary is organised may need to be considered in the context of child characteristics. The results of this study are therefore in contrast to studies which found that vocabulary was more easily located in a VSD e.g.,

Drager et al. (2003). It is important to note, however, that those studies were carried out with typically developing children as participants and the task was not communicative in nature. It is therefore possible that children with ASC would not benefit from VSDs in the same way (Wilkinson et al., 2012). Furthermore, for children who learned to use both displays relatively quickly, a grid display could be considered as a starting point for AAC systems from the outset as the VSD could be restrictive in terms of how the vocabulary is organised. Moreover, for children who are likely to learn to use an AAC system quickly, a VSD may potentially limit the child from building sentences in a generative fashion (Abbott and McBride, 2014).

One of the overarching aims of this research project is to provide clinicians with research evidence which will support decision-making of visual displays when making decisions about mainstream technology to be utilised as AAC devices for children with a diagnosis of ASC. Two of the participants in this study, Simon and Jake, learned to use both visual displays relatively easily, with few errors and in a few sessions. For children such as these it is suggested that the clinician could choose to commence intervention with a grid display as it would give the child access to greater vocabulary and complexity of language from the outset. For both children, neither of whom presented with sensory processing difficulties and who had adaptive functioning levels in the mild deficit range the decision-making process is a relatively straightforward one. For the other two participants, Nathan and David, however, the decision-making process is a more complex one. As neither Nathan nor David achieved criterion it is not possible to make recommendations about visual displays for children who present with a more complex profile of ASC. It is, however, possible that the choice of visual display is less important in the early stages. For these children, the integration of sensory processing interventions with teaching of AAC to support the child to be ready to learn could be the most essential element of the teaching process in the early stages. This is particularly relevant for clinicians who need to make decisions in relation to AAC for children with a diagnosis of ASC, as the prevalence of sensory

processing difficulties can be as high as 95% in this population (Tomchek and Dunn, 2007).

In conclusion, this study presented little evidence that the choice of visual display is important in learning to use a VOCA for children with ASC. It does, however, provide some food for thought on how child characteristics might impact on learning to use a VOCA. This is particularly relevant to the clinician's decision-making progress. Firstly, it is possible that lower levels of comprehension, social-communicative skills, and adaptive functioning might impact on the time required for a child to learn to use a VOCA. Secondly, it is possible that sensory processing skills should also be factored into the intervention process.

Limitations

Limitations of this study included the lack of social validity assessment which is important for determining caregiver opinions of the treatment and the two visual displays. There was a need for more intervention sessions so that all participants could achieve criterion. A further limitation was that it was not possible to provide two equal sets of reinforcers for each child. As a consequence, it is possible that one group of reinforcers was more reinforcing than the other potentially impacting the results in the direction of the more reinforcing set of toys and snacks.

Plan for Study 2

Given the fact that Nathan and David failed to achieve criterion in this study, the next study (Study 2) focuses on children who present with more complex profiles of ASC which include sensory processing difficulties. This is relevant as no research was found in the literature which describes the impact of sensory processing difficulties in the child with ASC when learning to use a VOCA. Furthermore, this is also relevant to the overall project aim as it may impact on decision-making for this client group. Consequently, in Study 2, sensory processing interventions are individually designed for each participant as part of the general procedures to support learning to use the VOCA for requesting

purposes. Furthermore, the teaching criterion is extended to include additional intervention sessions to provide the additional time that might be needed to learn to use the AAC system. This would then ensure that the learning criterion could be met for adequate comparison of the two visual displays. Finally, social validity is built into the study design in order to gain parental opinion of the two visual displays and the treatments carried out.

Chapter 4. Study 2

Teaching 4 preschoolers with Autism Spectrum Condition and sensory processing difficulties to request preferred items: A mixed methods study utilising a single case experimental design to compare a visual scene display and grid display using a voice output communication aid and a questionnaire to gain parental opinion of the intervention

4.1 Introduction

In the previous chapter, two of the four participants failed to achieve criterion and therefore it was not possible to fully determine if the choice of visual display is likely to impact on learning to use a voice output communication aid (VOCA) to learn to request. The children who failed to achieve criterion presented with sensory processing difficulties in addition to the autism spectrum condition (ASC) diagnosis. One question which arose from the study was whether it was possible that the presence of sensory processing difficulties impacted on their ability to learn to request using the VOCA. In view of this, it is possible that for children with ASC who have sensory processing difficulties, the addition of sensory processing strategies as an adjunct to the teaching of augmentative and alternative communication (AAC) use could lead to improved outcomes in learning to use the VOCA. This is because successful processing of sensory information which leads to readiness for learning could be an essential element of the teaching process (Schooling et al., 2012). Previous research e.g., Case-Smith and Bryan (1999) has indicated that sensory processing interventions can successfully be utilised to support behaviour changes. In an attempt to support all participants to achieve criterion with both visual displays, Study 2, therefore, includes the planned introduction of sensory processing interventions in all study phases. The treatment protocol was introduced during the intervention phase. This allowed the researcher to further explore whether there was a difference between learning to request with the two visual displays and if so, in what way.

Study 2 was designed to systematically replicate and extend Study 1 by ensuring that all participants also had a co-existing diagnosis of sensory processing difficulty which was formally assessed during the recruitment phase. Furthermore, social validity was included to gain parental perceptions of the two visual displays.

Based on the Study 1 results it was hypothesised that there would be no difference between learning to request using the two visual layouts. It was also hypothesised that children whose sensory processing difficulties are more severe are likely to take longer to learn to use the VOCA to request regardless of display layout.

The research questions for Study 2 were:

1. Can four children with a diagnosis ASC and co-existing sensory processing difficulties be taught to request with a VSD and grid display using a protocol developed for the study?
2. Which visual display: a grid display or a visual scene display is most efficient when used to support learning to request for children with a diagnosis of ASC and co-existing sensory processing difficulties?
3. How does severity of sensory processing difficulty impact on the learning to use and VOCA with two different visual displays to request?
4. What are caregivers' perceptions of the VSD and the grid display?

4.2 Methods

Reference can be made to Section 2.6 for a description of the overarching methodology upon which Study 2 was based. Sections 4.2.1 to 4.2.12 describe how the study was implemented in greater detail.

4.2.1 Participants and recruitment

Four participants who met the following criteria were recruited from the Access to Communication and Technology Unit (ACTU) waiting list:

a) Diagnosis of ASD from a psychologist prior to commencement of the study

b) Under age 6 years
c) Expressively non-verbal or less than 20 words which are used for functional communication.
d) Have a diagnosis of a co-existing sensory processing difficulty

A screening appointment was offered with both a speech and language therapist (SLT) and an occupational therapist (OT). During the screening appointment it was confirmed that the child was expressively non-verbal or used less than 20 words for functional communication through parental report and assessment of the child's expressive communication during the session.

Exclusion criteria were that there were no auditory/visual impairments that would impact on learning to use the AAC system.

The parents of all potential participants were given an information letter in Maltese or English (according to their choice) inviting them to voluntarily participate in the study (Appendix 2). Once consent to participate was gained from the parents the following assessments were carried out by the SLT and/or OT with the children:

1. Autism Diagnostic Observation Scale-2 (ADOS-2): Module 1 (Lord et al., 2012).
2. Vineland Adaptive Behavior Scale-2 (VABS-2; Sparrow et al., 2005)
3. McArthur-Bates Communicative Development Inventories-III (CDI-III): Words and Gestures (Fenson et al., 2007). Total Gestures section only administered.
4. Short Sensory Profile (SSP; McIntosh et al., 1999)

All child characteristics and the results of baseline measures are summarised in Table 4.1.

Table 4.1 Study 2: Summary of participant characteristics

	Participant			
	Mark	Zak	Sam	Andy
Age	3;05yrs	3;08yrs	4;02yrs	4;08yrs
Gender	Male	Male	Male	Male
Primary language	English	English	English	Maltese
Secondary language	n/a	Maltese	Maltese	n/a
ADOS-2 comparison score	10	10	9	10
Level of autism related symptoms	High level of autism-spectrum related symptoms	High level of autism-spectrum related symptoms	High level of autism-spectrum related symptoms	High level autism-spectrum related symptoms
Total gestures: Age Equivalent (CDI-III: Words and Gestures)	12mths	10mths	11mths	10-11mths
Description of expressive communication	Requests by bringing objects to adults. Can also point to request. Puts adult's arm on objects. No attempts at verbal language.	No attempts at verbal language. Brings object to an adult to request. Able to shake his head to indicate 'no' and may point to objects out of reach to request.	Able to say one word appropriately: 'no'. Throws himself on the floor to refuse. Rarely points to request desired objects. Pulls adult to requested items.	No attempts at verbal language, Occasionally brings edible objects to request food. Pulls adult to reinforcers to request desired items. Occasionally points to desired items. Rarely initiates communication.
Prior experience of AAC	Achieved Phase II of PECS to request several leisure items	Achieved Phase I of PECS to request one leisure item only	None	Requires prompting to use PECS at Phase I
Receptive communication (Vineland-2)	Age Equivalent: 1;01yrs Adaptive level: Low	Age Equivalent: 0;7yrs Adaptive level: Low	Age Equivalent: 0;7yrs Adaptive level: Low	Age Equivalent: 1;01yrs Adaptive level: Low
Expressive communication (Vineland-2)	Age Equivalent: 0;4yrs Adaptive level: Low	Age Equivalent: 0;3yrs Adaptive level: Low	Age Equivalent: 0;2yrs Adaptive level: Low	Age Equivalent: 0;2yrs Adaptive level: Low
Written communication (Vineland-2)	Age Equivalent: 3;06yrs Adaptive level: Adequate	Age Equivalent: <2;06yrs Adaptive level: Moderately Low	Age Equivalent: 2;10yrs Adaptive level: Moderately Low	Age Equivalent: 3;02yrs Adaptive level: Low
Communication composite (Vineland-2)	Adaptive level: Low :	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low

Gross Motor skills (Vineland-2)	Age Equivalent: 0;05yrs Adaptive level: Moderately Low	Age Equivalent: 2;10yrs Adaptive level: Adequate	Age Equivalent: 3;0yrs Adaptive level: Moderately Low	Age Equivalent: 1;07yrs Adaptive level: Low
Fine Motor skills (Vineland-2)	Age Equivalent: 0;05yrs Adaptive level: Moderately Low	Age Equivalent: 2;03yrs Adaptive level: Moderately Low	Age Equivalent: 1;10yrs Adaptive level: Moderately Low	Age Equivalent: 2;05yrs Adaptive level: Low
Motor Skills Composite (Vineland-2)	Adaptive level: Moderately Low	Adaptive level: Moderately Low	Adaptive level: Moderately Low	Adaptive level: Moderately Low
Daily Living Composite (Vineland-2)	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low
Socialisation composite (Vineland-2)	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low
Adaptive behaviour composite (Vineland-2)	Adaptive level: Low Standard score: 49	Adaptive level: Low Standard score: 56	Adaptive level: Low Standard score: 48	Adaptive level: Low Standard score: 36
Sensory Profile Classification	Overall score: 133 Definite difference	Overall score:107 Definite difference	Overall score: 111 Definite difference	Overall score: 137 Definite difference
	Hyper-reactive to sensory input	Hypo-reactive to sensory input	Sensory Seeking	Hypo-reactive to sensory input
	Definite difference in 3 areas: 1. Taste/Smell Sensitivity 2. Movement Sensitivity 3. Low Energy/Weak	Definite difference in 6 areas: 1. Tactile Sensitivity 2. Taste/Smell Sensitivity 3. Under responsive/Seeks Sensation 4. Auditory filtering 5. Low Energy/Weak 6. Visual/Auditory Sensitivity	Definite difference in 4 areas: 1. Tactile sensitivity 2. Taste/smell sensitivity 3. Under responsive/seeks sensation 4. Auditory filtering	Definite difference in 3 areas: 1. Tactile sensitivity 2. Auditory Filtering 3. Low Energy/Weak
	Probable difference in 1 area: 1. Tactile Sensitivity			Probable difference in 2 areas 1. Movement sensitivity 2. Underesponsive/ Seeks Sensation
Educational Placement	15 hrs of ABA input in the home environment per week	Full time mainstream	Full time mainstream	Full time mainstream

4.2.2 Setting and intervention context

All AAC intervention sessions were carried out in the ACTU clinic room as described in Study 1. Each participant was offered individual sessions. Sessions targeting sensory processing difficulties in the sensory motor room which was close to the AAC clinic room were offered to some children (Figure 4.1). Details of how the sensory processing interventions were provided and for whom are described in Section 4.2.8.1.

Figure 4.1 Sensory motor room

4.2.3 Materials

An iPad 4 encased in a Griffin Survivor case with iOS 10.2.1 software was used for all phases of Study 2. The Scene and Heard® application (app) version 3.0 was used on the iPad as the AAC app to ensure continuity with Study 1. Each participant's reinforcers were identified in the pre-baseline phase.

For the VSD layout, a photo of each child's reinforcers positioned on the bookcase in the ACTU clinic room in which the intervention was provided was taken and four hotspots, one for each reinforcer was created. Each hotspot emitted voice output recordings reflecting the verbal label when touched (Figure 4.2). Each hotspot was delineated with a red border which marked the space which could be activated for each reinforcer. For the grid display condition the display was designed in a grid layout which was configured with 4 hotspots in a 2x2 cell format programmed to emit a voice recording when activated (Figure 4.3). As all participants were boys, the voice recordings for both conditions were made in Maltese or English by a boy of similar age according to the participants' home language. In both displays, the voice recording for each hotspot was the name of the item.

Figure 4.2 Example of the VOCA configured for the VSD condition for Zak

Figure 4.3 VOCA screen display configured for the grid display condition for Sam

4.2.4 Study Design

Study 2, presented in Figure 4.4, was a single case experimental design (SCED) which utilised a multiple probe design (MPD) across participants consisting of pre-baseline, baseline-probe, comparison (intervention), post-intervention, and follow-up phases (Horner and Baer, 1978; Wolery et al., 2014). All participants commenced the baseline phase on the same day. Baseline probes were carried out once a week until the week prior to the commencement of intervention. In the week prior to commencing intervention each participant attended for three baseline sessions. The MPD supported the sequential introduction of intervention so the fourth participant remained in baseline for the longest period. A teaching protocol was introduced to teach requesting of reinforcers using an iPad as a VOCA with two different visual displays: a grid display and VSD during the intervention phase. To ensure that participants did not spend long periods in baseline, the commencement of intervention was staggered across participants and was therefore introduced one week apart (Gast et al., 2014). To allow

comparison of two treatments, an AATD (Barlow and Hayes, 1979; Wolery et al., 2014) was embedded in the MPD. The treatment conditions compared two types of visual layout: a VSD and a grid display (Figures 4.2 and 4.3). Each participant received a maximum of 18 sessions of intervention: nine in each condition.

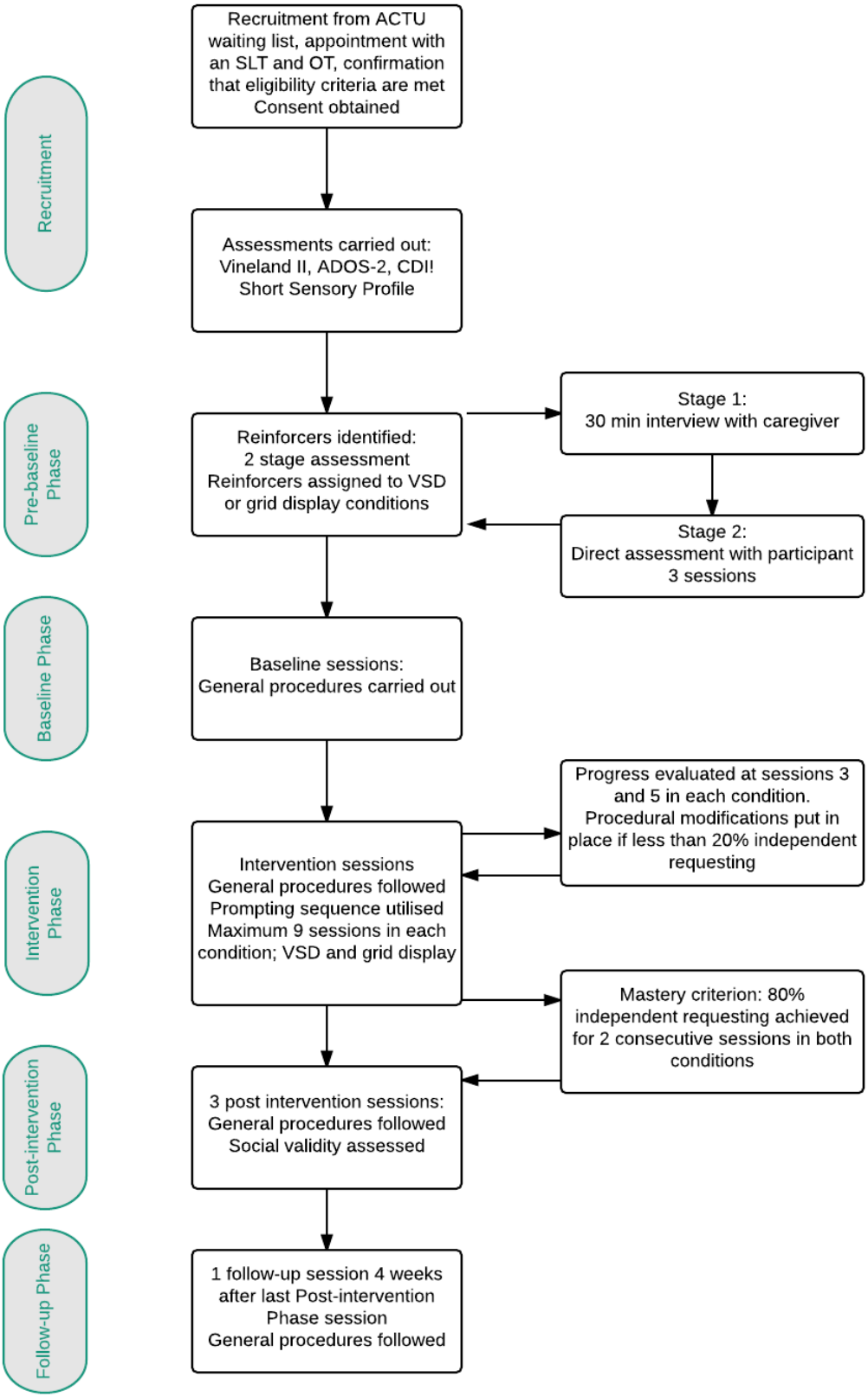

Figure 4.4 Study 2 phases

4.2.5 Pre-baseline phase: Identification of reinforcers

A two stage reinforcer assessment process (Figure 4.4) was utilised during the pre-intervention phase to identify the snacks and toys that would be used in the study for each participant (Kang et al., 2013; Stephenson, 2016). Reinforcers were used in the baseline, intervention, post-intervention, and follow-up phases.

An indirect assessment using a 30 minute caregiver interview adapted from Green et al. (2008) was used in stage 1 of the reinforcer assessment (Appendix 3). The assessment identified snacks and toys that the participant enjoys and which were suitable for intervention at ACTU. In stage 2, the stimuli identified in stage 1 were presented to the participants on three separate occasions over 1-2 weeks (Graff and Ciccone, 2002). The identified stimuli were then presented group by group: snacks and toys (DeLeon and Iwata, 1996). Each participant was encouraged to choose an item from each group. Once an item was chosen the participant was allowed to eat/drink it or play with it for a short time. This continued until no remaining items were left to choose from. The order the participant chose the stimuli was recorded by the researcher.

Snacks and toys were ranked separately using the formula (number of selections/number of offers) x 100%. Two sets of four reinforcers were created and each set randomly allocated to each of the two treatment conditions (Table 4.2) to ensure that change in requesting behaviour was not influenced by how reinforcing the items were (Wolery et al., 2014). Given the results of the reinforcer assessment it was only possible to create two groups of reinforcers that were equally reinforcing for Sam and Mark. Andy's reinforcers were calculated to be more reinforcing in the VSD condition. Zak's reinforcers were also slightly more reinforcing in the VSD condition. The parents of two of the participants, Sam and Mark, stated that their children did not have any interest in food and so for these participants it was decided not to use food as a reinforcer in the study. These two participants were offered only toys as reinforcers.

Table 4.2 Study 2: Preferred reinforcers

Participant	*VSD condition*	*Grid display condition*
Mark	Letterbox 50%, balloon 100%, playdoh 30%, Mr Potato Head toy 13.3%	Balls 33.3% , music 30%, pom poms 30%, Thomas tank toy 17.7%
Zak	Twistees snack 75%, shape sorter 30%, large blocks 100%, water 20%	Cars 75%, puzzles 17.5%, biscuits 60%, milk 50%
Sam	Money box 75% , letter box 60%, balls 60%, Shape sorter 50%	Cogs and wheels game 75%, balls 60%, foam letter puzzles 60%, puzzles 50%
Andy	Chocolate mousse 100%, money box 75%, Thomas tank toy 60%, balls 27.3%	Animals 50%, letter box 75%, croissant 60%, balloon 27.3%

4.2.6 Response definitions and measurement procedures

Spontaneous requesting, the dependent variable for both display conditions was defined as unsolicited picking up the VOCA, stretching out towards the communication partner with the VOCA, and then touching a cell on the screen to activate the voice output to suggest a request for a reinforcer. Data on all requests for reinforcers for the duration of each session in all phases of the study was collected using direct systematic observational recording (DSOR; Ayres and Ledford, 2014). This involved both clinicians observing and coding the requesting behaviour as it occurred in the session (Appendix 4). The percentage of independent responding was calculated post-hoc for each session using the formula: independent requests/ (independent requests + prompted requests + incorrect requests) x 100. Mastery criterion was considered achieved when the participant spontaneously requested on 80% of trials for two consecutive sessions.

4.2.7 Session schedule

Each participant attended for three sessions of AAC intervention of 20 minutes duration on a weekly basis. According to the assessment of sensory processing, some participants also attended for sensory processing sessions which took place in the sensory motor room before the AAC intervention session (see Table 4.3). Sessions were scheduled at the same time of the day and on the same days per week for each participant. The order of the treatments for each participant was

semi-randomised but with no more than two consecutive sessions of the same treatment thus ensuring that the dimension of alternation of the two treatments was not lost (Wolery, 2013). Randomisation was also applied to the tiers in the MPD. As each tier represented a participant, two participants randomly commenced with the VSD condition, and two with the grid display condition.

4.2.8 Procedures

4.2.8.1 General procedures.

General procedures were used across all study phases. Before entering the clinic room, the participant was shown a photograph of the screen display: VSD or grid display according to the condition planned for the forthcoming session. The researcher pointed to the items in the photo while saying "today you can ask for these things using the picture (referring to the VSD condition)/grid". Each participant had two personalised photographs reflecting the sets of stimuli identified in the reinforcer assessment. The two photographs were used to support discrimination between the two conditions (Schlosser, 2003c).

The reinforcers identified for the VSD and grid display conditions for each participant were made available on a shelf which was in sight but which could not be physically accessed by the participants. On entering the room, the participant was directed to the items on the shelf and asked "what do you want to do?". The participant was expected to make a selection by pointing, reaching or using the VOCA. If a choice was not made within 10 seconds, two reinforcers were selected by the researcher and offered to the participant to make a choice. If no choice was made within a further 10 seconds one of the reinforcers was replaced with another. This was continued until all four reinforcers were offered. If no selection was made after all four reinforcers were offered the session would be terminated. Once a reinforcer was selected, naturalistic strategies including environmental arrangement and waiting strategies were used to create more opportunities for requesting (Halle et al., 1981; Olive et al., 2007). Reinforcers were provided immediately once requested and the researcher acting as the communication

partner named the requested reinforcer. Participants were able to request as frequently as desired during a 20 minute period. All requests were recorded during the session by the communication partner on data sheets designed for the study (Appendix 4).

Given the recognition of additional sensory processing difficulties, a programme designed to target sensory processing difficulties was initiated for each child from the baseline phase. The sensory processing interventions provided by the OT varied according to each child's sensory processing needs which was determined by the results of the SSP administered in the recruitment phase (refer to Table 4.3 for an overview of the sensory motor activities carried out and the place and time these were carried out). All participants received sensory processing interventions during the AAC intervention session. Some participants also received sensory processing interventions in the sensory motor room prior to the AAC intervention. The sensory processing programme for each child is described in greater detail in Appendix 11. All participants received sensory processing interventions in the ACTU clinic and/or sensory motor room during all study phases. For Mark and Sam, the sensory processing interventions took the form of environmental modifications provided during all of the AAC intervention sessions e.g., providing a participant with a gym ball to sit on during the AAC intervention. For Zak and Andy sensory processing interventions entailed a session in the sensory motor room before the AAC intervention session with additional environmental modifications made during the AAC intervention sessions for some of the study sessions. For other sessions environmental modifications were provided during AAC intervention sessions only (see 4.2.8.4 Procedural Modifications for a further explanation).

Table 4.3 Study 2: Summary of participants' sensory processing program

Participant	***Sensory motor activities***	***Place/time where sensory motor programme was carried out***
Mark	Environmental modifications Vestibular Activities	Environmental modifications during all AAC study sessions in clinic room
Sam	Environmental modifications Proprioceptive input	Environmental modifications during all AAC study sessions in clinic room
Zak	Environmental modifications Vestibular input Proprioceptive input	Environmental modifications during all AAC study sessions in clinic room Sensory motor room access prior to AAC intervention sessions 8-16, post-intervention & follow-up phases
Andy	Environmental modifications Vestibular input Proprioceptive input	Environmental modifications during all AAC study sessions in clinic room Sensory motor room access prior to intervention sessions 3-6 and 13-16, post-intervention & follow-up phases

4.2.8.2 Baseline.

The baseline phase which was designed to collect data on the participants' current spontaneous requesting skills using the VOCA provided a baseline against which the effects of the treatment could be measured. Each baseline session of 20 minutes was divided into two 10 minute sessions: one for each display condition. The order of the conditions was randomly decided for each participant. The VOCA was available within reach of the participants during all baseline sessions. The participants were not directed to the VOCA or taught how to use it for requesting. All attempts to request reinforcers using pointing, reaching or vocalisations were honoured by the researcher by providing immediate access to the item.

4.2.8.3 Intervention

Intervention sessions were identical to baseline sessions except for the teaching protocol which was the independent variable. This was introduced to teach the participant to independently request using the VOCA in both intervention conditions. Prompting procedures utilised were identical to those used in Study 1 (Table 3.3). Requesting of at least two reinforcers per session was ensured by

using the phrase "let's tidy up and choose something else" if the child requested the same reinforcer for longer than 10 minutes. If a child played with the same reinforcer for more than 30 seconds, a natural cue e.g., "We have more animals" during animal play was used to encourage the child to request again.

Correspondence checks as described in Study 1 were utilised if the participant requested a different item from the current reinforcer e.g., if the child was playing with a puzzle, but touched shapes on the VOCA (Figure 3.5). This ensured that there was correspondence between the visual graphic touched on the display and the reinforcer the participant wanted. If there was no correspondence the error correction sequence described in Study 1 was utilised (Figure 3.6). Each participant received a maximum of nine sessions in each condition.

4.2.8.4 Procedural modifications

To afford individualised modifications that were sensitive to the ethical responsibilities associated with this study, some changes were made to the procedures. A change was made to Zak's sensory processing programme from session 8 in the intervention phase because he was not making the expected progress. Furthermore, there was great variability in his results. It was therefore decided by the OT that he would benefit from time in the sensory motor room prior to the AAC intervention sessions in the clinic. Andy did not access the sensory motor room between intervention sessions 7 and 12 due to a fractured leg although he continued to receive sensory processing interventions within the AAC clinic room during the intervention sessions.

4.2.8.5 Post-intervention

Each participant received three sessions in the post-intervention phase which were identical to baseline. Two participants randomly commenced with the VSD condition, the other two with the grid display condition.

4.2.8.6 Follow-up.

Maintenance was assessed in one session four weeks after the last post-intervention session. Procedures were identical to those in the baseline phase. The session commenced with the VSD condition for two participants, and with the grid display condition for the other two participants.

4.2.9 Procedural fidelity

As was described in Study 1, a SLT was the independent observer who recorded procedural fidelity data (section 3.2.9). The observer collected data for 37% of all sessions to assess reliability of the implementation of research procedures (Appendix 6). The percentage of sessions in each phase in which data was collected and the data range for each participant are presented in Section 3.4.2 below.

4.2.10 Inter-observer agreement

Inter-observer data including number of independent requests and prompted trials was collected live by both clinicians: the SLT and the OT, who implemented all sessions in the study. For each session, percentages of agreement between the independent observer and the researcher were calculated using the formula: agreements/ (agreements + disagreements) x 100 (Ayres and Ledford, 2014).

4.2.11 Social validity

Social validity was assessed using a questionnaire which was given to parents to complete (Appendix 7). The questionnaire was based on the Treatment Acceptability Rating Scale-Revised (TARF-R; Reimers and Wacker, 1988) with further adaptations by Boesch et al. (2013). It consisted of 11 questions which were rated on a 5 point Likert Scale. On this scale, a score of '5' indicates the most positive rating, a score of '1' is the least positive with the exception of questions 4 and 9 which were reverse coded. Six open-ended questions relevant to the study were added by the researcher to gain further insight on caregivers' opinions of the two displays used in the study.

4.2.12 Data analysis

The data was graphed for each participant and a visual analysis of the data carried out to identify if there was a functional relationship between the introduction of the two treatments and requesting behaviour (Figure 4.5; Section 4.3.3). The analysis included a visual examination of Figure 4.5 data for trend, level, and stability within and between the VSD and grid display conditions for each participant (Lane and Gast, 2014). Data which was used to determine the relative efficiency of the two display conditions is also presented in Section 4.3.3. Supplementary calculations are available in Appendix 5. The data from the 11 questions which were rated on a Likert Scale in the social validity questionnaire were analysed using descriptive statistics. The open ended questions were transcribed and analysed using thematic analysis (Section 4.3.4; Braun and Clarke, 2006).

4.3 Results

The results of the SCED are presented first. These are then followed by the results of the social validity assessment.

4.3.1 Procedural fidelity results

Procedural fidelity results for each participant in each phase of the study are displayed in Table 4.4. The overall mean for all four participants was 98.8%. Over the course of the study ninety-nine percent (range, 96%-100%) procedural fidelity was calculated for Mark. Ninety-eight percent (range, 90%-100%) procedural fidelity was calculated for Zak, while procedural fidelity was calculated at 99% (range, 97%-100%) for Sam. For Andy, procedural fidelity was calculated as 99% (range, 95%-100%). Calculations of procedural fidelity were made by dividing the number of observed behaviours by the number of planned behaviours multiplied by 100 (Gast, 2014b).

Table 4.4 Study 2: Procedural fidelity results

	Baseline probe	***Intervention***	***Post-intervention***	***Follow-up***
Mark	100%	97.9%	100%	100%
Zak	98.5%	94.3%	98%	100%
Sam	98.5%	99.3%	99%	100%
Andy	97.5%	98%	100%	99%

4.3.2 Inter-observer agreement results

The mean percentage of inter-observer agreement across all participants was 98.7% (Section 4.2.10). For all sessions with Mark inter-observer agreement was 97.6% (range, 92%-100%), for all sessions with Zak 98.4% (range, 93%-100%), for all sessions with Sam 99.7% (range, 98%-100%), and for all sessions with Andy was 99% (range, 96%-100%).

4.3.3 Participant results

4.3.3.1 Baseline

The study results for all participants are displayed in Figure 4.5. Dashed lines between sessions indicate missed sessions and are evident in Mark's, Andy's, and Zak's data. A stable zero performance was evident in the baseline for all participants in both display conditions as none of the participants utilised the VOCA to request. Mark, Sam and Andy all exhibited behaviours which can be described as app violations in the baseline sessions as they tried to use the AAC app for other purposes than its intended use. In Mark's case app violations included repetitive touching of the hotspots of his most favoured reinforcers. Zak and Sam touched the hotspots of their favourite reinforcers on one or two occasions but otherwise did not show any particular interest in the VOCA. Andy attempted to push the home button on the VOCA in baseline sessions 1, 2 and 4 in an attempt to exit the app.

4.3.3.2 Intervention overview

On introduction of the intervention, an abrupt change in the level of independent requesting was evident for two participants: Mark and Zak, both of whom commenced with the grid display condition. Sam demonstrated a delayed increase in independent requesting in the intervention he commenced with: the VSD condition. For Sam, the level of independent requesting increased during the second session of intervention which was the grid display condition. Andy also exhibited a delayed increase in independent requesting in the VSD condition. Change was evident in the third session of intervention which was the first grid display session.

Efficiency data for individual participants and the overall group are also presented in Table 4.5. When taken as a group, the mean performance requesting scores were higher in the grid display condition (55.2%) than the VSD condition (43%). The mean performance scores for the post-intervention phase were higher than the intervention phase for both conditions. Performance in the post-intervention phase was 78.8% in the VSD condition which was slightly higher than the grid display condition which was 77.1%.

For Mark, Sam and Andy, the number of sessions to criterion ranged between four and eight sessions for both conditions. Zak achieved mastery criterion on his ninth session in the VSD condition while failing to achieve criterion in the grid display condition, although his results in the follow-up sessions were within criterion for both conditions. As Zak failed to achieve criterion in the grid display condition it was not possible to calculate the mean number of sessions to criterion as a group and therefore not possible to make a comparison between the two conditions.

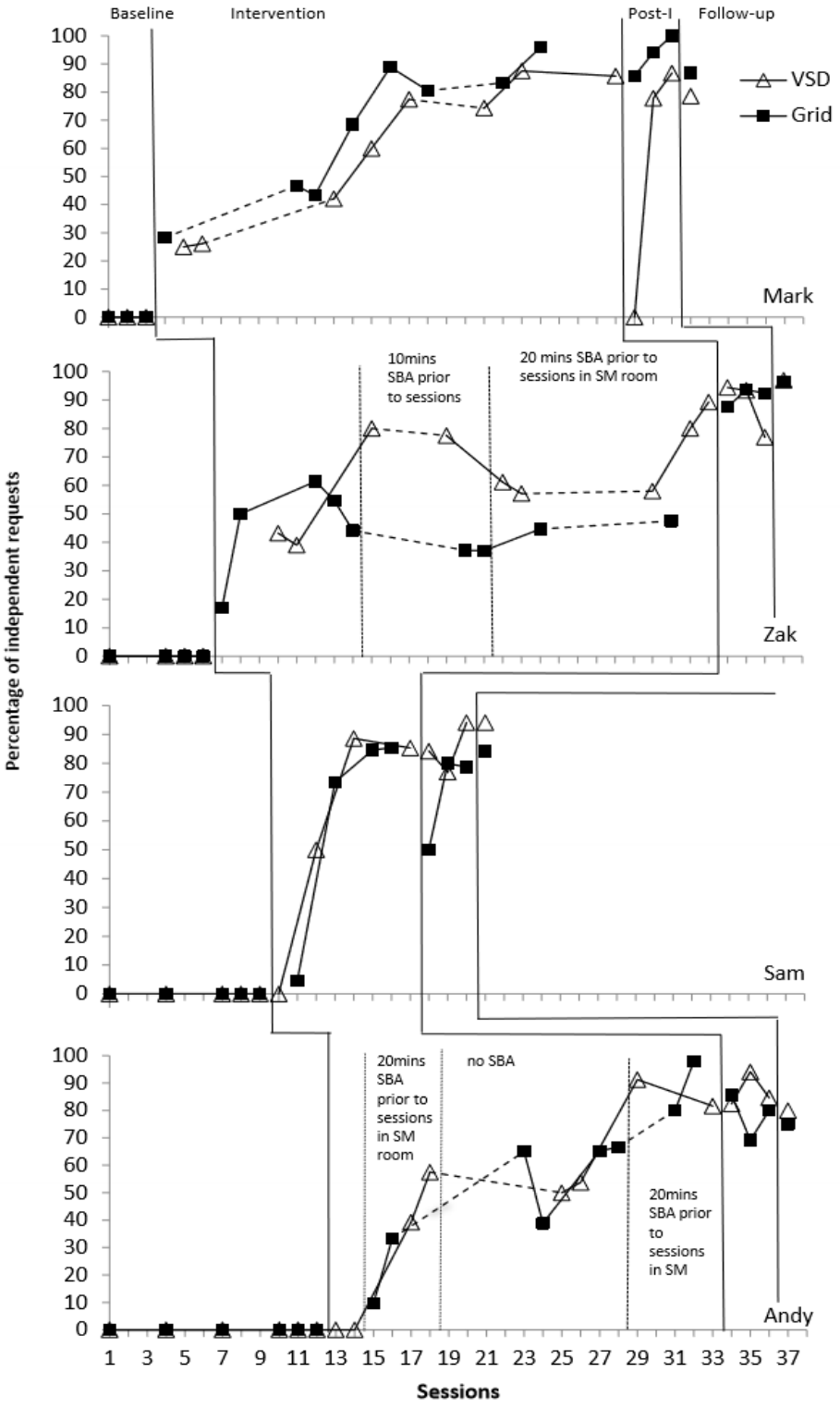

Figure 4.5 Percentage of correct requests for the VSD and grid display conditions *Note*. Dashed lines indicate missed sessions. SBA are sensory based approaches. SM refers to the sensory motor room.

Table 4.5 Study 2: Efficiency data for the VSD and grid display conditions.

	VSD					Grid display				
Participant	**Baseline %**	**Intervention %**	**Post-intervention %**	**Errors to criterion %**	**Sessions to criterion**	**Baseline %**	**Intervention %**	**Post-intervention %**	**Errors to criterion %**	**Sessions to criterion**
Nathan	0	12.5	74.1	87.5	Not achieved	0	16.1	85.7	83.9	Not achieved
Simon	0	67.9	96	32.1	4	0	88.9	92.9	11.3	3
Jake	0	93.1	99.1	6.9	2	0	86.1	96.7	13.9	3
David	0	47.2	65.5	52.8	Not achieved	0	37.9	71.4	62.1	Not achieved
Overall (mean)	0	55.2	82.9	44.8	N/A	0	57.3	86.7	42.8	N/A

Overall, the mean percentage of errors during the intervention phase was slightly higher in the grid display condition. As Zak failed to reach criterion in the grid display condition, the data presented in Table 4.5 includes the percentage of errors for all nine sessions of intervention in this condition. Mark, Sam and Andy demonstrated a higher percentage of errors in the VSD condition. Zak's results, on the other hand, indicate a greater mean percentage of errors in the grid display condition.

Percentage of non-overlapping data (PND) scores for each participant are displayed in Table 4.6. The PND scores for Mark and Zak indicated that the intervention was highly effective for both the VSD and grid display conditions. For Sam and Andy, the intervention was highly effective in the grid display condition but fairly effective for the VSD.

Table 4.6 Study 2: PND metrics from baseline to intervention for the VSD and grid display conditions

Child	***VSD***	***Grid display***
Mark	100%	100%
Zak	100%	100%
Sam	75%	100%
Andy	75%	100%

Each participant's individual performance results are described in greater detail in the sections which follow. For each participant, a description of the results which provide an interpretation of the data graphed in Figure 4.5 and tabulated in Table 4.5 are referred to. Each participant's performance in the post-intervention and follow-up phases is described. Reference is made to the sensory processing interventions which were provided in an attempt to ensure responsive interventions for each child.

4.3.3.3 Mark

Mark required eight sessions to reach criterion in the VSD condition and six sessions in the grid display condition (Figure 4.5). There was no overlapping of data points. Data points in the grid display condition were just above those of the VSD condition throughout the intervention phase.

Mark touched the hotspot representing the reinforcer he wanted from the baseline phase but needed to be taught specifically how to pick up the VOCA and extend with it towards a communication partner. In the second session (first VSD session) Mark exited the VSD page to find the grid display. Additional guided access features were used to restrict Mark from exiting the chosen display for each intervention session. After six sessions (three in each condition) Mark began to choose who to make requests from. This involved spontaneously walking with the VOCA before touching the screen to complete his request to either his mother or the OT. The majority of errors after intervention session 7 were due to touching the display before picking up the VOCA. After intervention session 9, Mark began the requesting sequence and finished it by pressing two hotspots after each other e.g., 'ball' and 'music'. This appeared to be a request for both reinforcers at the same time. Mark was also observed to be quite specific about how he touched each hotspot e.g., he touched the edge of the hotspot for a ball if the ball he wanted was not the same as the one in the photo. On other occasions, despite clearly wanting a balloon he refused to request using the photo of the balloon in the grid display condition. This appeared to be because the visual representation was not the same colour as the balloon he wanted.

In his post-intervention phase, the mean level of requesting was higher than the intervention phase for the grid display but lower for the VSD (Table 4.5). This appeared to be because Mark refused to make any requests in the first post-intervention session with the VSD and communicated this by putting the VOCA back on the shelf. The session in which Mark refused to use the VOCA led to greater variability in the VSD condition. Mark's independent requesting in the

session in the follow-up phase was within criterion for the grid display condition but slightly below for the VSD condition.

Mark, who presented with a hyper-reactive sensory seeking pattern was provided with sensory processing interventions which involved environmental modifications in during study sessions in the AAC clinic room (see Table 4.3). These were used throughout the intervention sessions although they were less necessary as the intervention phase progressed.

4.3.3.4 Zak

Zak achieved criterion on the ninth intervention session in the VSD condition, the final session of the intervention phase, thus the trend was an accelerating one. He failed to achieve criterion in the grid display condition during the intervention phase but did meet criterion during the post-intervention phase when the prompting protocol was no longer being applied. For both conditions there appeared to be three distinct data paths within the trend during the intervention phase. Initially there was an accelerating trend which was followed by a decelerating trend and finally an accelerating one. The overall trend for the grid display condition was a decelerating one. The data paths intertwined on one occasion early in the intervention phase. There was greater variability in the VSD condition than the grid display condition.

On observation it appeared that Zak's errors were due to rushing to request and mistakenly activating the voice output of a hotspot close to the edge of the display when picking up the VOCA. He also frequently hit adjacent cells within the display with other fingers while aiming for a specific hotspot. This was particularly evident in the VSD condition. Less errors of this nature were evident as the intervention phase continued. After intervention session 9, Zak occasionally double tapped on the screen quite deliberately. This was interpreted to mean 'hurry up!'. Zak missed a number of sessions during the intervention phase (see dashed lines in Figure

4.5). Due to missing 10 sessions in total, it took him 12 weeks to attend for 18 sessions.

For the first seven intervention sessions, Zak, who presented with a hypo-reactive sensory processing pattern, received sensory processing interventions in the form of environmental modifications in the AAC clinic room as the researcher OT felt he required during the session. From session 5, however, Zak's results indicated an emerging decelerating trend which appeared to be due to randomly touching the VOCA display after 10 minutes of intervention time and this resulted in greater errors. In view of this, the researcher OT decided to provide Zak with 10 minutes of sensory processing interventions in the AAC clinic before commencing the AAC intervention but Zak's results continued to indicate deceleration. Further informal assessment of his sensory processing skills by the researcher OT indicated additional difficulties with postural control so a further decision was taken to provide him with 15 minutes of sensory processing interventions in the sensory motor room prior to each on-going intervention session in the AAC clinic. An accelerating data path was then evident which continued into the post intervention phase.

In the post-intervention phase Zak made continued progress particularly in the grid display condition. As Zak had already achieved criterion in the VSD in the intervention phase, the change in level in the grid display condition was greater. Overall, Zak appeared extremely focused when requesting in this phase; in both conditions. He spontaneously walked with the VOCA to request a car from his mother in his final post-intervention session. Zak attended for one follow-up session four weeks after his last post-intervention session and requesting in both display conditions was higher than in the post-intervention phase.

4.3.3.5 Sam

Sam reached criterion in four sessions in both intervention conditions (Figure 4.5). In the first VSD session (first intervention session) there was no change from the

baseline. Errors were due to touching the display before picking up the VOCA. He began to make progress towards the end of session 2 when he began to pick up the VOCA and reach with it before touching the display. There was an abrupt change in independent requesting in the grid display condition from intervention session 1. Both mean and median scores were higher in this condition. Intertwining of the data paths was evident.

Sam resisted physical prompting to support him to touch the correct hotspot for some reinforcers despite clearly wanting to play with these. These included the letters for a letterbox as these were not depicted in the photo of the letterbox, similarly he did not want to request the shapes using the graphic visual provided as the photo did not include all the shapes. When requesting balls, Sam was very specific about where he touched within the hotspot as not all balls were present in the visual. He was observed to touch the blank area in the hotspot for balls he wanted that were not represented in the graphic visual.

In the post-intervention phase, the mean percentage of independent requesting was stable and higher than the intervention phases for both conditions. Three sessions, one in the VSD condition and two in the grid display condition were below criterion. This was possibly due to the change of reinforcers midway during the session that was planned to ensure that both conditions were assessed in the same session. He was always above criterion for the first treatment condition. In the final follow-up session the percentage of independent requesting was either the same or higher than the last session of the post-intervention phase.

For Sam, who presented with a sensory seeking pattern, a variety of environmental modifications were provided within sessions and these continued to be necessary throughout the intervention phase.

4.3.3.6 Andy

Andy achieved criterion in both display conditions after eight sessions of intervention in each condition (Figure 4.5). Once intervention commenced there was no change in independent requesting for the first two sessions resulting in a delayed increasing trend in the VSD condition. An abrupt accelerating trend was evident with the introduction of the grid display condition (session 3). Although the overall trend was an accelerating one for both conditions, there appeared to be three data paths within the trend for both conditions. This included a decelerating trend between intervention sessions 6 and 9. This coincided with a period of missed sessions due to a fractured leg. An accelerating trend was then observed in the grid display condition from intervention session 9, and from session 5 in the VSD condition.

The data paths intertwined on several occasions. Errors in the early stages appeared to be due to poor eye-hand co-ordination as he looked at the hotspot representing the reinforcer that he wanted but touched somewhere else on the screen. This was confirmed with correspondence checks. Andy also appeared to have difficulty physically lifting the VOCA in the early stages but this resolved as the intervention phase progressed. Requests which were counted as errors were due to inadvertently touching a hotspot while lifting the VOCA. There were also errors due to requesting of food items but correspondence checks indicated that he did not want the items when offered them. When observed more closely, it appeared that Andy was attempting to remove the visual from the display rather than touch it. His mother stated that this was more likely a communicative attempt to say 'I don't want croissant'.

Andy attended for three post-intervention sessions. The percentage of independent requesting remained within criterion for the VSD. Two of three grid display sessions were also within criterion. Errors were due to inadvertently touching adjacent hotspots when requesting. Andy did, however, make a second attempt to touch the desired hotspot after the voice output was emitted thus

evidencing some self-correction. In general, it was noted that Andy was becoming more alert as the post-intervention phase continued as he exhibited a desire to explore other objects in the room. Due to this he needed a lot of coaxing to request the reinforcers on his VOCA displays. Requesting remained within criterion for the VSD in the final follow-up session. In the grid display condition it was slightly below criterion.

Andy, who presented with a hypo-reactive sensory processing pattern accessed sensory processing interventions in the sensory motor room prior to the AAC intervention sessions. Environmental modifications were also made in the AAC clinic room. Due to Andy's fractured leg, some sessions were missed. When he returned all access to the sensory motor room was stopped (intervention session 7) and a decision was taken to continue to provide AAC intervention in the AAC clinic room with only environmental modifications. Access to the sensory motor room was reinstated at intervention session 13.

4.3.4 Social validity results

The mothers of all four participants completed the social validity questionnaire independently. The results of the first section which assessed their opinions of the intervention strategies and their impact on the children using a 5 point Likert scale are presented in Table 4.7 in Section 4.3.4.1. The results of the second section of the questionnaire which consisted of open ended questions designed to support the caregivers to compare the two visual displays and their impact on learning to request during the intervention are visually presented as a thematic network in Figure 4.6 (Section 4.3.4.2). Transcripts for the open ended questions and their analysis are found in Appendix 12.

4.3.4.1 Quantitative results

The first section of the TARF-R involved responses on a Likert scale ranging from 1-5 in which higher scores are considered to be more positive. The exception to this are questions 4 and 9 which were reverse coded indicating that a lower score

is considered more positive. A general conclusion would suggest that the mothers found the intervention strategies to be very clear and very acceptable. All mothers were "very willing" to implement these strategies in the home. Whilst all mothers were "very confident" that these strategies would make permanent improvements to their child's communication, the potential disruption that it would have on home life was rated between "not at all disruptive" to "quite disruptive" mainly due to the potential impact of using an iPad on siblings in the home setting. All mothers rated the impact of the intervention on requesting as having "many effects" whilst stating that there were "some effects" on socialisation. The impact of the intervention on emerging speech was rated between "no effects" and "some effects" as two children verbalised in imitation during the interventions on a few occasions.

Table 4.7 Study 2: Social validity questionnaire results

Question	***Mean response***	***Range of responses***
1. How clear is your understanding of the interventions strategies implemented with your child	4.8-Very clear	4-Clear 5-Very Clear
2. How acceptable do you find the intervention strategies to be regarding your concerns about your child?	4.5- Acceptable to very acceptable	3-Neutral 5-Very acceptable
3. How willing are you to use these intervention strategies at your home?	5-Very willing	Not applicable
4. To what extent do you think there might be disadvantages in following these intervention strategies?	1.5-Not at all likely to a little likely	1-Not at all likely 3-Neutral
5. How likely are these intervention strategies to make permanent improvements in your child's communication?	4.5-Likely to very likely	4-Likely 5-Very likely
6. How much time would be needed each day for you to implement these strategies?	3.25-Neutral	2. A little time will be needed 4. Some time will be needed
7. How confident are you that these strategies will be effective?	5-very confident	Not applicable
8. How disruptive will it be to your home life to implement these intervention strategies?	3.25-Neutral	1-Not at all disruptive 4-Quite disruptive
9. To what extent are undesirable side-effects likely to result from these intervention strategies?	1.25-No side effects are likely	1-No side effects are likely 2-A few side effects are likely
10. Have you noticed any positive effects on your child's communication in any of the following areas?		
a) Improvements in requesting skills	5-many effects	Not applicable
b) Better social interaction with others	4.25-some effects	3-Somewhat 5-Many effects
c) Emerging speech	1.75-Some effects	1-No effects at all 3-Somewhat

4.3.4.2 Qualitative results

Reflexive thematic analysis as described by Braun and Clarke (2006) was used to identify themes within the qualitative data The qualitative data from the open ended questions in Part 2 of the questionnaire were coded and The theme which was identified was: Parental perceptions of using a VOCA to support communication.

The theme consisted of subthemes which were derived from the data after coding. The theme and corresponding sub-themes was presented as a thematic network and is discussed below with participants' quotes to support the discussion (Figure 4.6; Braun and Clarke, 2006)

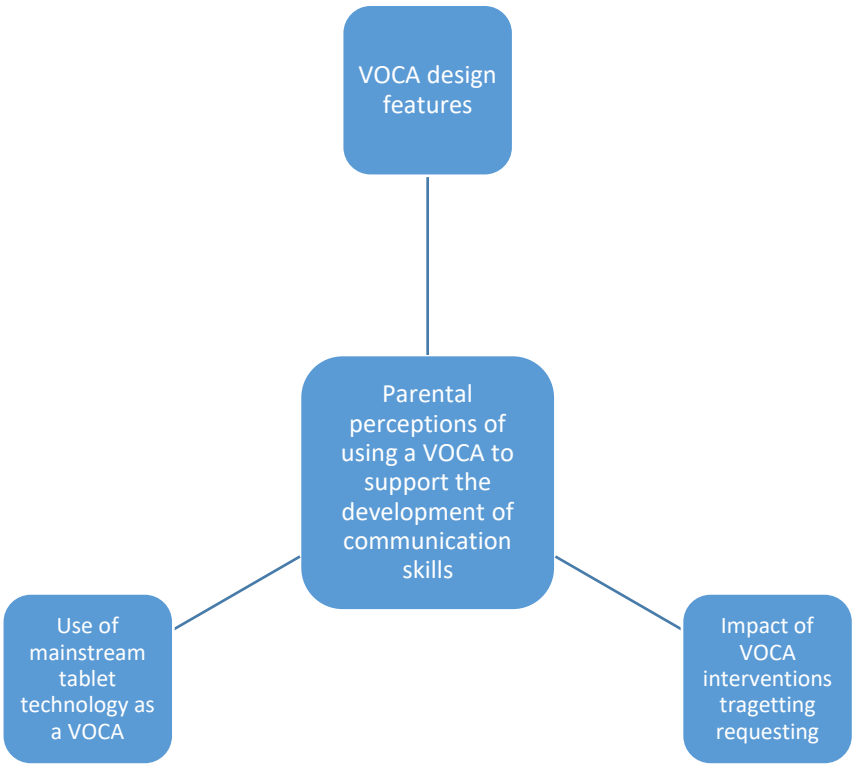

Figure 4.6 Study 2: Thematic network for the social validity results

Parental opinions were summarised by three sub-themes; firstly, the design features of the VOCA which was used in the interventions, secondly, the use of mainstream tablet technology as a VOCA, and thirdly, the impact of the intervention which was designed to teach requesting skills.

Subtheme1: VOCA design features

The focus of this sub-theme was on how the displays impacted on learning to request and how they felt that the displays impacted on the children's ability to request from a motor perspective.

All parents verbalised a preference for the grid display layout. In general, the parents stated that this layout was clearer:

> Sam's mother: *Squares are clearer, easier to find*

The parents perceived the VSD as being more confusing and too colourful. They also referred to the hotspots which were made explicit using a red border for the study and the proximity of each of the hotspots to other hotspots in the display:

> Mark's mother: *The VSD confuses me, maybe the red (squares)…The colours blend too much*
> Zak's mother: *The squares are too close together in the picture (VSD)*

Two of the parents felt that their children's progress was better with the grid display layout:

> Zak's mother: *He made less mistakes with the grid*
> Mark's mother: *I think he did better with the grid*

The other two parents felt that the display itself did not make any difference to their child's ability to learn to request:

> Andy's mother: *If he really wants something the display does not matter, he will touch the correct place*

The parents' responses also included their perception of how the visual layout impacted on the children's abilities to effectively locate the correct hotspot on the display. This theme is closely connected to how parents perceived the visual displays as the parents felt that the grid display was more likely to result in greater accuracy:

> Zak's mother: *I think the grid was more comfortable to touch…He was more precise with the grid*

Conversely, the parents stated that the VSD was likely to result in more mistakes being made when their children were learning to use the VOCA to communicate:

> Zak's mother: *He made more mistakes with the VSD, pressing the squares next to the one he wanted*
> Andy's mother: *He would try to touch one (hotspot) but might hit another*
> *Zak's mother: The pictures are on top of each other, especially the middle two*

Subtheme 2: Use of mainstream tablet technology

This sub-theme focussed on parental comments related to the use of mainstream technology to support their children to communicate and factors which they perceived might influence the success of this in the home environment.

Parents expressed their concerns about their children's communication and the impact of communication difficulties in other environments outside of the home:

> Mark's mother: *I understand him, but how will he be communicating with other people in school?...I want him to communicate with others, his teaching assistant*

Even though parents had concerns about their children's communication, the parents were generally positive about the idea of using an AAC system to support the development of expressive communication. They specifically referred to the iPad to support communication skills:

> Mark's mother: *I think everyone should learn to use a tablet if they cannot speak…grateful to have a chance for my son to learn to use a tablet to communicate*

While parents were positive about using the iPad as an AAC device they expressed concerns about how it would be used as home and if the child would try to continue to use the iPad for other purposes such as watching videos and playing games:

> Sam's mother: *My fear is that he will mix it all up and try to exit the (AAC) app.*

Sam's mother was concerned that he would not find the same need to communicate with an iPad at home making reference to how the clinic environment was different to the home environment:

> Sam's mother: *At home, he is different, he can get what he wants himself, he knows where things are.*

Sub-theme 3: The impact of intervention

The third sub-theme referred to the areas of the children's development which the parents perceived that the interventions impacted. The parents of the participants reported that the intervention impacted on three areas: their children's communication, their socialisation skills, and an impact on their general behaviour.

As requesting was the communicative behaviour taught in the study it was expected that the parents would perceive progress in this area, particularly in relation to the sessions carried out at ACTU:

> Sam's mother: *He was asking for things…He was deliberate with pointing (on the VOCA), deliberate with asking for what he wanted*

The parents, however, also stated that their children were initiating more requests in situations outside of the clinic:

> Andy's mother: *He will try to find a way to tell you what he wants*
> Zak's mother: *He improved as he can ask for what he wants*

Requesting from other adults (not just parents) was also perceived to be a benefit of the intervention:

> Andy's mother: *He is asking for things from others (adults) now*

The parents also reported improvements in other areas of the children's communication. This included general communication e.g., persistence to communicate and non-verbal communication skills:

> Andy's mother: *He is more persistent, gets angry if he is not understood*
> Zak's mother: *Since the intervention started he is much less frustrated, he used to whine a lot and I didn't know why*

Furthermore, parents reported progress in their children's non-verbal communication in a range of areas including eye contact, and use of objects and gestures for communicative purposes:

> Mark's mother: *Eye contact has improved… Waving bye now*

Zak's mother: *At home he has started bringing me objects, if he wants to go out he grabs my hand and puts it on the door, for a drink he brings me a bottle…He is using gestures more, also to show 'stop' he puts my hand over my mouth*

Parents also perceived that the intervention impacted on their children's socialisation skills. They reported that their children were showing more interest in other adults:

Mark's mother: *He is socialising more with different people and immediately relating to others, not just me (mum)…He is paying attention socially more*

Improved play skills was considered to be another impact of the intervention:

Zak's mother: *He used to ignore others but now he will play with others*

Sam's mother also reported a positive impact on behaviour in terms of how Sam behaved in the intervention sessions:

Sam's mother: *He co-operated*

Andy's mother also reported other positive impacts of the intervention in terms of how Andy behaved outside of the sessions:

Andy's mother: *He is experimenting more, exploring everything…He is noticing more things.*

4.4 Discussion: Study 2

The first aim of this study was to determine if the protocol developed for teaching the participants to request with the VOCA in Study 1 could be applied to four more participants. Furthermore, in Study 2, the participants who had ASC also had a co-

existing diagnosis of sensory processing difficulties. Sam, Andy and Mark all met criterion in both conditions and therefore the protocol was successful for these three participants. Zak achieved criterion in the VSD condition only but his data for the grid display condition in the post-intervention phase was also within criterion. The use of the protocol was therefore successful for three participants but less successful for Zak.

The second and fourth aims of Study 2 are discussed together as both were related to a comparison of the acquisition of requesting skills between the VSD and grid display layouts. The second aim focussed on the quantitative results thus the number of intervention sessions to criterion and percentage of errors for each participant in each display was therefore compared (Schlosser, 1999a; Gast and Spriggs, 2010). The fourth aim concerns the perspectives of caregivers and the results are therefore viewed as a way of gaining information which determines the real world significance of the SCED results thus enhancing the interpretation of the quantitative data.

The number of sessions to criterion for each visual display was compared for only three of the participants as Zak failed to achieve criterion in the grid display condition within the nine intervention sessions which were scheduled for each visual display. It is possible, however, that Zak achieved criterion in the VSD condition because his reinforcers were calculated to be slightly more reinforcing in that condition. This may have then predisposed him to achieving success in the VSD condition in the sessions allocated for intervention. .

Sam and Andy achieved criterion in both visual displays in the same number of sessions: four for Sam, and eight for Andy. For these two children there did not appear to be any difference between learning to request in the two display conditions. As Andy's reinforcers were calculated to be more reinforcing in the VSD condition, however, it could be expected that he would have achieved criterion first in that condition but this did not happen. It is possible that the

difference in how reinforcing the toys and snacks was not important; or it is possible that for Andy, the organisation of vocabulary on the display was not an important factor in learning to use the VOCA. Another explanation of the results is that criterion might have been achieved in the grid display in less sessions than the VSD condition but because the items were more reinforcing in the VSD condition the number of sessions to criterion was then the same for both conditions. Mark achieved criterion in the grid display layout in less sessions than the VSD. He required six for the grid display and eight for the VSD. Furthermore, visual inspection of Mark's data paths indicated that they did not intertwine at any stage so in his case the grid display condition was more efficient than learning to use the VSD. Mark exhibited an interest in other graphic symbols which were present in the room e.g., graphic symbols which were used to label the items stored in cupboards and were made from the same symbol set as the pictures in his PECS book: Picture Communication System (PCS). PCS is a graphic symbol system which consists mainly of pictographic symbols (Mizuko, 1987). It is possible that as Mark had some experience of PECS, visuals organised in a grid layout were more familiar to him (as they were stored in this way inside his PECS book) and this may have positively influenced his progress with the grid display on the VOCA display. Prior to the study, however, Mark had only achieved Phase II indicating that he had learned to request using picture exchange but only one visual was available to him at one time so it remains unclear if his prior knowledge of PECS would have influenced the outcome of the study towards the grid display condition.

For three of the participants: Mark, Sam, and Andy, the percentage of errors was slightly lower in the grid display condition. This is interesting as the two groups of reinforcers were equivalent for Mark and Sam. For Andy, the reinforcers were more reinforcing in the VSD condition but this did not appear to support Andy to make less errors in that condition. The results of this study suggest that the way the grid display is organised may have supported the children to make fewer errors. This is in keeping with results from eye tracking research which has been

conducted with children with ASC and has indicated that children with ASC might be more efficient to locate visuals organised in a grid array (Gillespie-Smith and Fletcher-Watson, 2014). Parental perception was also that the grid display was more helpful in supporting requesting in terms of its organisation and appearance. The parents perceived the VSD layout as cluttered, too colourful and preferred the visual appearance of the grid. Interestingly, no parent made any reference to the human figure in the VSD, or to the natural context in which the reinforcers were embedded.

Zak was the only child who had a higher percentage of errors in the grid display condition. Zak's results were particularly variable and there was a decline in correct percentage of requesting in both conditions particularly the grid display condition after session 12. There was, however, a large increase in percentage of correct requesting between the last point of the intervention phase and that of the post-intervention phase, so much so, that Zak's results in the post-intervention phase in the grid display condition were above criterion despite having failed to achieve criterion in this condition during intervention. It is possible that learning to communicate with the VSD supported Zak to learn to use the grid display in later sessions. It is also possible that the slightly more reinforcing items represented in the VSD condition supported him to make less errors in that condition. A further explanation could be a sensory processing one as it was noted that Zak's sensory processing was at an optimal level after receiving sensory motor interventions in every session after session 16 of intervention. This had not been achieved previously and he may have needed the preceding sensory motor sessions to achieve this. Jordan and Lofland (2016) state that when arousal levels are at an optimal level this supports the child to engage purposefully and that without this, successful intervention can be difficult to achieve. Prior to intervention session 16 Zak frequently attempted to make requests too fast, without focusing on the screen, resulting in errors. Being at a more optimal arousal level may have supported him to make more accurate requests resulting in less errors.

Although the kinds of errors made during the intervention were not formally recorded, observations of these were made by the researchers. Some of the observed errors were equally prevalent regardless of the visual display and could be classified into three kinds. The first kind of errors were due to inadvertently touching the screen and activating the voice output while picking up the VOCA to request a reinforcer. Such errors were particularly evident in the early stages of intervention for all the participants. As the motor pattern for requesting with the VOCA became more established these kinds of errors appeared to decrease. Voice output not relating to the reinforcer being requested is, however, confusing for the child, especially in the early stages of intervention when the child is still learning how to request with the VOCA. This then raises the issue of app design which should take into account ease of use (Ganz, 2015). It could be argued that mistakenly activating the voice output could also be prevalent using a dedicated VOCA but this could be minimised through the use of other available touch settings which are more typically available in such devices or through the use of a keyguard.

A second kind of error was one which appeared to be a repetitive and stereotyped behaviour (RSB). Watt et al. (2008) define RSBs as tapping and swiping of objects. Tapping, in particular, was a behaviour which was required in order to activate the voice output to request in this study. Undesired tapping, which is not related to requesting behaviours can be considered as a RSB (King et al., 2017). In this study, the behaviour observed was one where the participant requested a desired item using the behaviour chain taught but then compulsively touched another visual for a reinforcer which was not desired. Zak made a number of errors of this kind during intervention. Such behaviours in relation to iPad usage have also been described by King et al. (2014). It is, however, unclear if these are specifically related to the use of mainstream tablet technology being used as a VOCA or if they would also be present in a dedicated AAC device.

Another type of error exhibited by Andy initially appeared to be a RSB. This involved deliberately requesting a reinforcer repetitively but then indicating rejection using gestures to push away the requested object during the correspondence check. This happened repeatedly despite the use of the error correction sequence implemented after the correspondence check. Closer inspection of the behaviour indicated that he was not tapping the visual of the reinforcer on the display but trying to swipe it off, thus communicating rejection. This raises the issue of focusing solely on requesting as an initial communicative skill but not on the communicative skill of rejection (Sigafoos and Reichle, 1991). Traditionally, AAC interventions have focused on teaching requesting as a first communicative skill (Still et al., 2014). In choosing requesting as a starting point, clinicians could inadvertently be limiting the range of communicative functions which the child has access to from the outset of intervention yet it is imperative to provide opportunities to learn a range of communicative functions (Ganz, 2015). In a grid display, the solution is to programme additional cells which can be combined with the vocabulary to provide access to other communicative functions but how this could be done with a VSD is unclear.

The third aim of the study was to investigate whether severity of sensory processing difficulty impacted on learning to use the VOCA to request with the 2 different visual displays. Although all four children had scores falling in the definite range, Zak's sensory processing score assessed by the SSP was the most severe while Andy's was the least yet these two children took the longest to learn to use the VOCA for both conditions. Mark, on the other hand, had a score indicating slightly more severe sensory processing difficulties than Andy but learned to use the grid display for requesting in less sessions. The variability in learning to request does not appear to be related to the severity score from the SSP but it is possible that it is related to the sensory processing pattern of each child. A closer look at the children's sensory processing patterns indicates that they were quite different and that this heterogeneity may have impacted on their progress in the study.

Sam presented with a sensory seeking pattern. Once environmental modifications were consistently utilised in the clinic room where he was taught to request he was more organized and able to learn what he needed to do with the VOCA to request. Watson et al.'s (2011) research indicates that children with a sensory seeking pattern are likely to experience difficulties in developing their communication skills yet once AAC intervention was put in place Sam learned to use the VOCA to request reinforcers in a relatively small number of sessions (four sessions in each condition). It is possible that the environmental modifications which were utilised from the first baseline session supported Sam from the outset to modulate his arousal levels so that he could learn the motor behaviour necessary to communicate with the VOCA. Anecdotally, Sam was much calmer after the first baseline sessions although it was necessary to continue to use the environmental modifications throughout the study.

Apart from the environmental modifications, the choice of reinforcers may also have played an important role in Sam's progress as these were novel toys which he was very interested in and he therefore initiated requests frequently presenting the clinicians with many opportunities to teach him to request. The use of novelty with children who present with a sensory seeking pattern has been suggested by Vismara and Lyons (2007) and was utilised as a strategy to keep Sam's attention. This included presenting him with different kinds of the same reinforcer e.g., the balls presented to him were not just the ones depicted on his visual display. Sam was observed, however, to be extremely reluctant to touch the visual if the exact ball was not depicted in the visual. Eventually he began to activate the voice output by touching the area within the hotspot which did not have a ball. Similar behaviour was observed with different kinds of reinforcers including shapes for the shape sorter, balloons (different colours), and letters for a letter box. It has been stated that overattentiveness to visual stimuli may be considerably present in children with ASD (Liss et al., 2006). Furthermore, Wilkinson et al. (2012) have suggested that children with ASC may have greater difficulty with a VSD layout due to this tendency to focus narrowly or in an over selective fashion on details

and this was certainly the case for Sam. For such children this raises the issue of whether the use of symbols in AAC displays could be more suitable from the outset as they are symbolic representations of objects. This also has potential implications for the use of a VSD which may contain other objects/colours which may inadvertently stimulate such overattentiveness.

Mark was assessed as presenting with a hyper-reactive sensory pattern. He displayed similar overfocussing as Sam: refusing to request a balloon using the VOCA if it was not the same colour as the one in the photo on the display despite clearly wanting it. He also began to touch around the balloon in the hotspot in order to request other balloons. Over-attentiveness to visual stimuli has been suggested to be particularly prevalent in a hyper-reactive pattern (Liss et al., 2006). The sensory strategies recommended to modulate Mark's arousal levels included the use of environmental modifications such as calling his name prior to talking to him, and use of animation which were necessary throughout the study. This is likely to be due to Mark's difficulty to shift his attention from non-social stimuli to social stimuli which has been documented as a difficulty for children with ASC (Landry and Bryson, 2004). Other sensory strategies were implemented to provide vestibular input although once Mark attended for more sessions he required less of this within sessions and allowing him movement throughout the sessions was sufficient. This may have been due to increased anxiety levels in the initial sessions which decreased as the sessions went by. It is possible that Mark presented with increased arousal levels and RSBs in the early sessions due to anxiety which decreased with the provision of predictable routines as the intervention sessions were implemented (Lytle and Todd, 2009).

The final two children, Zak and Andy, were initially classified as presenting with a hypo-reactive pattern. Following observations made by the researcher OT during baseline sessions, she stated that Zak also had difficulties in other sensory processing areas: sensory-based motor disorder (postural disorder), and a sensory discrimination disorder. These observations, combined with variability in Zak's

progress in intervention, led to a decision to provide sessions in the sensory motor room prior to AAC intervention after session 8. Although, evidence for the existence of specific sensory subtypes is still emerging, DeBoth and Reynolds (2017) state that there is evidence for a group of children with ASD who have global sensory processing deficits with sensory impairments across sensory domains. The authors state that for these children there is likely to be a great impact on functioning in other areas e.g., communication skills, and that this group of children may need more time to respond to interventions. This may, therefore, be a reason that Zak took the longest to learn how to use the VOCA to request reinforcers. In Zak's case, it was during his eighth VSD intervention session that it was felt that he had finally met optimal arousal levels in sessions in the sensory motor room. Prior to this, he presented as disorganized, inattentive, and with significant RSBs. After this session, Zak presented as much more focused during his AAC sessions in the clinic and he maintained this in the follow-up session. He also began to correct himself if he inadvertently hit the incorrect hotspot. In his final session, Zak spontaneously requested a car from his mother using the VOCA without having been specifically taught how to do this.

Andy, diagnosed as having a hypo-reactive pattern required eight sessions to reach criterion in both conditions. Research has indicated that children with ASD and hypo-reactiveness are most likely to have difficulties with social communication and language as this group of children may fail or be delayed when orienting themselves to novel stimuli (Watson et al., 2011). Andy received sessions in the sensory motor room from the outset of the study. After the third intervention session, his time in this room was doubled to twenty minutes. In the early stages of intervention Andy appeared to be able to learn the motor behaviour required to request with the VOCA but had difficulty to co-ordinate his hands and eyes to select the correct hotspot. This did not appear to be due to difficulty with visual discrimination as he looked at the hotspot corresponding to the desired reinforcer. After the intervention in the sensory motor room was increased Andy began to make good progress but as he fractured his leg he was not able to use the sensory motor room between intervention sessions 7 and 12 in

the intervention phase. When the interventions provided in the sensory motor room were stopped Andy appeared less organized and less alert. There was also increased variability in his results, with a decelerating trend in the VSD condition. Once the sensory processing interventions were reintroduced, Andy reached criterion in both conditions. In Andy's case, the comparison between the periods of when he had intervention in the sensory motor room and when he did not suggest that his hypo-reactive pattern could have had a greater impact on his ability to learn to use the VOCA had the sensory motor interventions not been put in place.

This study sought to build on the findings of Study 1 by ensuring that all the participants had a co-existing diagnosis of ASD and sensory processing difficulty. Furthermore, all participants' sensory processing was assessed prior to baseline sessions and a sensory processing programme was designed and implemented on an individual basis as an adjunct to the AAC intervention. The caregivers were also able to participate through social validity.

In Study 2, three participants were able to achieve criterion in at least one visual display thus allowing comparison of their progress in learning to use the two visual displays. The fourth participant achieved criterion in the VSD only. The use of additional sessions in the intervention phase and the planned use of sensory processing interventions may have been factors in achieving this. Yet again, however, there was variability in learning to use the VOCA. All of these participants had ADOS-2 scores indicating a high level of autism symptoms. All had adaptive functioning scores falling in the moderate range except Andy whose score was severe yet Zak took longer to achieve criterion and did not achieve criterion in both displays.

Similar to the findings from Study 1, participants who had the lowest scores on the Total Gestures section of the CDI-III and therefore the lowest levels of early social-communication skills took longest to learn to use the AAC device to request:

Zak and Andy. Again, all participants had sensory processing difficulties but there did not appear to be a relationship between severity and the progress made by the participants in the study, similar to Study 1.

The differing participant sensory processing patterns may, however, have had some influence on their progress. This is consistent with the literature which states that the variation in sensory processing difficulties is likely to contribute to the heterogeneity of children with ASD (Baranek et al., 2005). In particular, children with a hypo-reactive pattern are likely to present with lower adaptive functioning scores (Liss et al, 2006) which may account for the time taken to learn to communicate with the VOCA in Andy's case. Furthermore, a child such as Zak who presented with global sensory difficulties is likely to have difficulties learning to use a VOCA as this impacts on learning in many areas (DeBoth and Reynolds, 2017).

Study 2 provides evidence from four more children on the use of VSDs versus grid display. Study 2 results were consistent with those provided in Study 1 as yet again there was limited evidence that a VSD might provide an advantage over a grid display or vice versa when it comes to learning to request with a VOCA. Furthermore, in Study 2, caregivers were able to offer their opinions of the two display layouts and while two parents saw no difference between learning with either display, the other two perceived the VSD as disorganised and possibly impeding learning from an access point of view. It is important to allow caregivers the opportunity to express their opinions as stakeholder perspectives are as meaningful as the participant's results as one of the elements of EBP (Schlosser, 2003d). Furthermore, there is a likelihood that if parents perceive an intervention as impeding learning they are less likely to implement it in the home setting (Schlosser, 1999b)

Limitations

This study presents with some limitations including a lack of a generalisation phase. Such a phase could include generalisation to requesting from other people, in other places/situations, or of other reinforcers. Two children, however, spontaneously made requests from their mothers during the sessions exhibiting some form of generalisation as they had not been taught to do this (Alzrayer et al., 2014).

One issue which could be considered a limitation is that all participants accessed sensory processing interventions during the entire study so it is not possible to say how they would have progressed without these. Andy's results, however, provide a glimpse of this scenario as there was a period during his intervention in which he was unable to access the sensory motor room due to a fractured leg. During this period, he did not maintain his previous progress indicating that the sensory processing interventions provided him with the support he needed to learn to use the AAC system to request. Further evidence of this is provided in Zak's results as he only made progress in learning to use the AAC system late in the intervention phase and it appears to coincide with when he began to access sensory processing interventions in the purposely designed room. In the planning stages of Study 2 sensory processing interventions provided only in the intervention phase were considered but it was decided that this would confound the results making it difficult to attribute the learning to request with the AAC device solely to the AAC intervention provided in the intervention phase.

Plan for Study 3

In view of the sensory interventions provided in Study 2, Study 3 was planned as a qualitative study in which the OT who co-provided interventions in Studies 1 and 2 was interviewed. This was important as Study 2 provided some evidence that there was a need to further explore how speech and language therapists can work in collaboration with OTs when providing AAC interventions to some children with ASC. The data gathered in Study 3 was planned to accomplish two main purposes:

firstly to gain insight into her opinions of how the sensory motor interventions impact on the implementation of AAC interventions when working with children with ASC. The second aim was to gather further data on the relevance of choosing to use a VSD or a grid display when selecting an AAC display for children with ASC.

Chapter 5. Study 3

An occupational therapist's opinion of Augmentative and Alternative Communication interventions for children with Autism Spectrum Condition: An interview

5.1 Introduction

The overall focus of the present thesis is to provide clinicians with information which would support their decision-making process when working with minimally verbal preschoolers who have a diagnosis of autism spectrum condition (ASC) and are candidates for augmentative and alternative communication (AAC) as a mode of communication. Studies 1 and 2 focussed on the decisions which can be made in terms of how vocabulary is arranged on the AAC device display: namely a visual scene display (VSD) and a grid display. Both of these studies failed to provide sufficient evidence that one of these vocabulary layouts presented any real advantage over the other in terms of supporting the child to learn to request reinforcers. Furthermore, this was substantiated by parental opinion in Study 2 who expressed the opinion that there was no difference in how their children progressed with either display although some did express a preference for the more traditional grid display.

While the organisation of vocabulary on the display is one of the decisions which must be made by the clinician, other issues which could impact learning to use an AAC system perhaps have also emerged. In particular, the sensory processing patterns of each child could be an important factor in learning to use a voice output communication aid (VOCA) which the clinician may need to consider in the early stages of the intervention process. This specific issue was partially addressed in Study 2 in which the AAC interventions were combined with sensory processing interventions to support each child on an individual level to learn to use the VOCA for requesting purposes. These interventions were assessed for and designed by the occupational therapist (OT) who provided the interventions in both Studies 1

and 2. In view of the results to date, and her involvement in the provision of these interventions, it was decided to interview the OT as it was felt that her opinions might make a useful contribution to the next stage of research as well as providing corroboration of the participant results from Studies 1 and 2. Gaining the OT's opinions therefore could provide some data which is related to the overarching research question concerning how speech and language therapists (SLTs) could improve clinical outcomes when making decisions for AAC interventions for children with ASC. It was also felt that the OT could provide further information on the issue of child characteristics and the impact of these in the AAC intervention process as well as the features of interventions which could be considered when making clinical decisions.

The overarching research question for the interview with the OT was:

> How should AAC interventions be provided to children with ASC who are minimally-verbal?

The main aims of the interview were to:
a) explore the OT's perceptions of the two visual displays: visual scene display and grid display,
b) explore the OT's perceptions of her role in providing AAC interventions to the children who were participants in Studies 1 and 2,
c) identify any clinical insights from an OT perspective which could be taken into account when planning Study 4.

The OT's perceptions were investigated using a semi-structured interview to elicit her opinions and thoughts on teaching children with a co-existing diagnosis of ASC and sensory processing difficulties to use a VOCA to communicate requests.

5.2 Methods

5.2.1 Research design

A qualitative research design was selected for this study and further detail which describes the overarching methodology for this choice of research design is provided in Section 2.6. The research design was a qualitative research interview chosen in order to explore and gain an in depth understanding of the OT's opinions about providing AAC interventions (Greenhalgh and Taylor, 1997a; Magnusson and Marecek, 2015). Furthermore, it was the intention that this qualitative study be used to define preliminary questions which could then be addressed in the next study (Greenhalgh and Taylor, 1997a).

Thematic analysis was used to identify themes in the data set (Braun and Clarke, 2013). This involved searching across a data set to find repeated patterns of meaning (Braun and Clarke, 2006). Specifically an inductive approach was taken to the coding of data so that the researcher's analytic preconceptions were limited as much as possible, thus there was no pre-existing coding frame (Braun and Clarke, 2006). Further detail describing the analytical process can be found in section 5.2.7.

5.2.2 Ethical approval and informed consent

Approval for the interview was obtained from the Ethics Committee at Manchester Metropolitan University (Appendix 1). A consent form was signed by the OT indicating her willingness to be interviewed (Appendix 2).

5.2.3 The researcher

The researcher was a SLT with experience of delivering AAC interventions to children with ASC. She was the author of the present thesis as well as the SLT who provided the clinical interventions described in Studies 1 and 2.

5.2.4 Preparing for the interview

5.2.4.1 Interview guide

In order to answer the research questions, study-specific questions for the interview were created by the researcher. Questions were open-ended so that the OT could contribute her perspective of AAC interventions for children with ASC without the constraints of close-ended questions (Yin, 2015). The guide was designed to include a range of follow-up questions which served to clarify and elaborate on responses to obtain additional information (Creswell, 2014). The interview guide can be found in Appendix 8.

5.2.4.2 Piloting the interview guide

Pilot testing of the interview guide was carried out prior to the implementation of the study to identify any weaknesses, flaws or limitations in the interview design (Turner, 2010). This also served to identify any potential researcher biases that could potentially influence the outcomes of this study (Chenail, 2011). Pilot testing was carried out with an OT with similar interests to the identified participant for the main study and questions were discarded or reworded following the pilot testing (Chenail, 2011).

5.2.5 Participant

The participant was a female OT who had paediatric clinical experience. She was known to the researcher as a colleague who worked on the same AAC team and also provided interventions in conjunction with the researcher for children with ASC in the Studies 1 and 2. This participant was selected as the researcher was particularly interested in her opinion of the interventions provided in these studies. The OT was given an information sheet outlining what would happen in the interview and the reasons for it (Appendix 2). Once the OT consented, the interview was scheduled.

5.2.6 Data collection

The semi-structured interview was carried out in a one to one setting in a clinic room at Access to Communication Technology Unit (ACTU), the researcher and participant's place of work. This was the place where Studies 1 and 2 had also been carried out. The interviewer was the researcher who was also a colleague.

The interview lasted 60 minutes and was recorded using the SmartRecorder application (app; version 4.0.7.1) downloaded on an iPad Air 2. The recordings were transcribed verbatim using a notational system described by Magnusson and Marecek (2015; Appendix 13). A copy of the transcript was sent to the participant for her verification.

5.2.7 Data Analysis

The six phase procedure for thematic analysis described by (Braun and Clarke, 2006) was followed to analyse the data (Figure 5.1). The first phase involved repeated reading of the transcribed data in an active way to search for meanings and patterns within the data (Braun & Clarke, 2006). In Phase 2, the data was coded so that a list of initial codes was produced from the data. All data extracts were coded manually and this supported the researcher to organise the data into meaningful groups (Tuckett, 2005). The coding framework was devised based on the salient issues which arose from the text itself, thus the coding framework was data driven and the themes derived in the latter phases of the analysis were based on the data itself (Braun and Clarke, 2013). Recoding of the data took place four weeks after initial coding to increase dependability of the results (Krefting, 1991). Phase 3 involved sorting of the codes into potential themes. In this phase, the researcher began to consider the potential relationship between codes, between themes, and between levels of themes (Braun and Clarke, 2006). In Phase 4, the researcher reviewed the themes and constructed a thematic network to fit the data set. Thematic networks are visual tools which illustrate the themes and subthemes and the interconnections between them (Braun and Clarke, 2006).

Phase 5 involved the defining and naming of themes and in Phase 6 the thematic network was described and analysed (Sections 5.3 and 5.4).

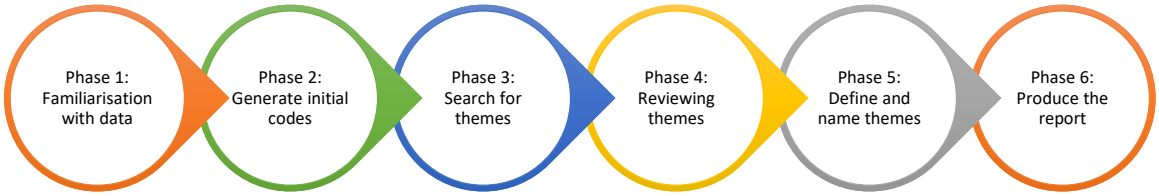

Figure 5.1 Steps in the analyses of transcribed data (adapted from Braun and Clarke, 2006)

5.3 Results

5.3.1 Participant

The participant was an OT employed on the same team as the researcher. She had 12 years of experience in the area of paediatric occupational therapy of which eight years were specifically in the field of AAC interventions for children with ASC. She had also completed a Master's degree in Inclusive Education and Communities. She stated that she had not completed Ayres Sensory Integration (ASI) training but had done some courses in the area and was experienced in delivering sensory processing interventions.

5.3.2 Thematic analysis

A transcript of the interview can be found in Appendix 13. A total of 167 codes were identified in Phase 2 of the analysis and these were grouped together and then utilised as the subthemes and themes for the thematic network constructed in Phase 4 (Braun et al., 2019). Coding of the data set is located in Appendix 14. Appendix 14 also contains the analysis of the original data into the grouping of codes to form subthemes which were utilised to form the basis for the themes.

Three themes were identified from the data which summarised the concepts and ideas expressed at lower levels.

The theme: *Heterogeneity requires individualisation of interventions* referred to the need for interventions to be tailored to the individual child. Another theme: *Child-clinician connections are important* focused on the need for the clinician to create a connection with the child with ASC as fundamental to achieving success in interventions. The theme: *Ways to improve AAC intervention outcomes* explored potential knowledge gaps and ways of working which could be considered to improve outcomes for children with a diagnosis of ASC.

The three themes were unified by the overarching theme: *An occupational therapist's opinion of interventions for children with ASC.* This is represented visually by the thematic network in Figure 5.2. An earlier draft of this figure was shown to the participant for validation and further adjustments were made according to her input. The discussion of each theme will be supported by text taken from the data set.

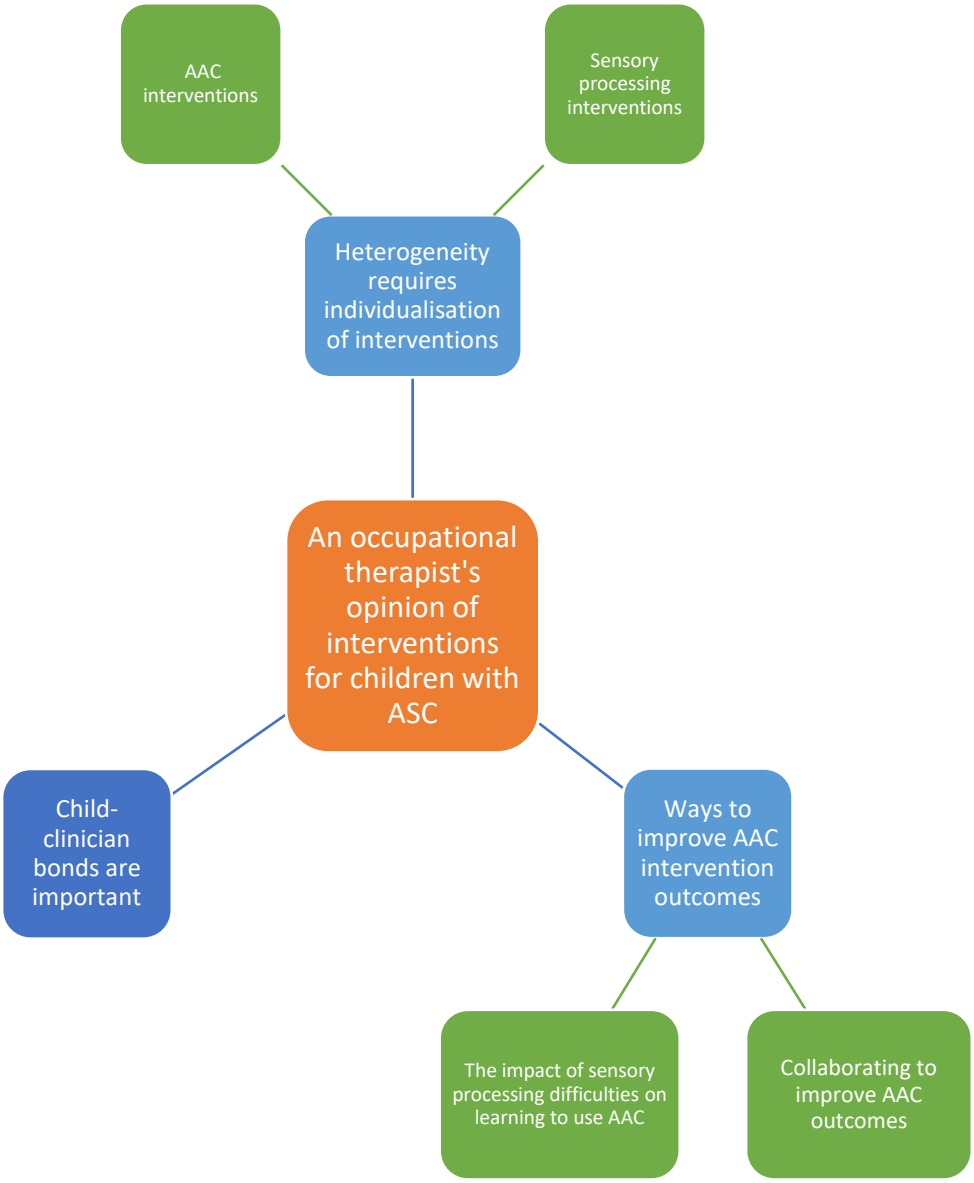

Figure 5.2 Thematic network for the interview with the OT

Theme 1: Heterogeneity requires individualisation of interventions

The theme **Heterogeneity requires individualisation of interventions** referred to the OT's opinion that when interventions are provided to children with ASC they must be individualised due to the heterogeneity which is found in this group of children. As the OT generally spoke about two areas of interventions for children with ASC, this theme consisted of two subthemes: ***AAC interventions*** and ***Sensory processing interventions***.

The first subtheme was concerned with the need to ensure that providing **AAC interventions** to children with ASC are carried out on an individual level. In order to do this, the OT talked about the assessment of the child. In her opinion, the results of an assessment allows the clinician to make decisions regarding how interventions should be carried out for the difficulty which the particular child presents with; as illustrated in this quote:

> *…so what we've done is analysed the situation, we identified where the difficulty is that the child is having in the process of communication and we taught specifically the person with regards to that [emm] specific difficulty*.

There was a sense of the need to carefully plan and choose intervention strategies for each child on an individual level due to the diversity which can be found in the group of children diagnosed with ASC. The OT talked about the need to find the right balance of interventions because each child is different. This is summed up in the quote below in which the OT stated that she used some AAC intervention strategies with some children but not with all of them:

> *Okay, there are a number of strategies that I use, not always I think using the same strategies apply for, like [emm] you might use some strategies for some children and not for others.*

In referring to different AAC strategies which need to be considered at the level of the individual child, the OT spoke of the need to consider the context within which the AAC device is taught, ensuring that it is taught in multiple environments:

> *…I think that is very important [er] that you make sure that this is taught across environments….*

The OT also considered other ways in which the teaching of the use of an AAC device may needs to be individualised to the child: such as how the device is

positioned to ensure optimal visual access, and the use of additional equipment which could be used to support the child to be more accurate when touching the display:

> *We have adapted the environment in order to meet the needs of that particular [emm] student, for example, if a student had problems to access the device we had made it [emm] in their visual field maybe using other keyguards or make it possible that that person accesses the device eas- as easily as possible*

The teaching strategies which can be utilised to teach AAC use which are typically utilised by clinicians were also referred to within this subtheme of AAC interventions. The OT referred to the use of strategies which have their roots in Applied Behavioural Analysis (ABA) for use within AAC interventions, such as physical prompting, backward chaining, fading of prompts as well as the use of task analysis:

> *Then other strategies that I think work from my, from what I have observed is the use of structured teaching and the use of backward chaining and that you start teaching bit by bit [emm] how they need to use the the communication book or the device…*

She stated that each child with ASC may respond differently to AAC intervention strategies. In this quote below she noted that for some children there may be very rapid progress using established AAC practices from the area of ABA:

> *… I think teaching AAC device use you go with like behavioural strategies of like [emm] physical prompting, modelling and I think those would be just enough and then you fade, you do the fading accordingly they will learn to use. Some of them probably, you show them once and they are able to do it.*

While one of the focuses of the OT was how the AAC interventions themselves need to be adjusted for each child on an individual level, she also talked about the hardware that might be used for the AAC system. This included her opinion on how the vocabulary should be organised on the device display. When asked for her opinion of the two display layouts, VSD and a grid display, she perceived no significant difference between the display layouts:

> …*but I don't think the criterion was not achieved because of the display…*

Despite her opinion that organisation of vocabulary was unlikely to impact the outcome of the AAC intervention, there appeared to be some individual circumstances in which the OT felt that the grid display could be more helpful to support the child to locate vocabulary e.g., when a child with ASC had visual scanning difficulties, although she then reiterated that the use of one display over another was unlikely to have a great impact on the outcomes:

> *There were children who have I think visual, visual scanning problems that I think the grid helped them much more but I don't think there was much of a difference because we had children who were doing very well with both with both [emm] scenes, oops, with both the grid and the scene*

Based on her involvement in Studies 1 and 2, the OT stated that the use of the two different visual displays, a VSD or a grid was, in her opinion, not so important in making progress in learning to use the VOCA. For children who had difficulty to learn to request, she perceived that child characteristics such as the presence of sensory processing difficulties to be more likely to influence outcomes:

> *I don't think it's the most important thing (the VSD or the grid display) because I've seen the same problems of [emm] mainly the problems that were, that were affecting the child in order to learn or to use the device is*

because it was being interfered by the need to [emm] get the sensory input…

The second subtheme in the theme **Heterogeneity requires individualisation of interventions**, focussed on the provision of **sensory processing interventions** for children with ASC. The OT noted that not all children with ASC present with sensory processing difficulties. For children with ASC who do present with sensory processing difficulties, she gave examples of how differing patterns of sensory processing difficulties may present in the child:

You can be registering a lot so that you makes you sensitive, [emm] you can seek also and this is very easy to notice in children because you see them jumping, you see them moving, you see them pushing and pulling or anything or maybe like trying to make noises etcetera so you can see the seeking and then there are children who avoid who avoid being with people, who avoid [emm] certain activities [emm] etcetera…

The OT's responses indicated a clear need to conduct an assessment in order to determine the extent of the sensory processing difficulty. The OT described the various types of assessments utilised. These included parental questionnaires, standardised assessments and observations, the results of which are then integrated to determine the extent of sensory processing difficulty. The OT also stated that the assessment results are then used to guide her choice of interventions, thus interventions are individualised for each child:

I think information from all of these [emm] assessments will give you the opportunity to interpret what is going on in that child and then you plan your intervention accordingly.

Statements made by the OT clearly indicated that sensory processing interventions are goal driven, the overall aim being to restore the sensory systems according to

child specific sensory needs. She used the term 'just right' to describe the balance of the sensory systems which was her ultimate goal and which she described as necessary for attention skills:

> *…just right is the ability to have attention [emm] to maintain attention which is appropriate and you have the appropriate level of energy for that particular activity, that you can maintain attention and can concentrate.*

The possibilities for sensory processing interventions were also discussed by the OT. She noted that this could include the provision of strategies chosen for the child which would be utilised within sessions:

> *…for example…if a child is seeking movement [emm] we [emm] try to allow movement within the session…*

The OT also referred to environmental modifications which could be used to support the child:

> *[emm] another thing is putting structure, that is putting [emm] a table [emm] which is facing [emm] like less distractive environment like a clear wall so you lessen distractions*

Decisions regarding sensory processing interventions went beyond the strategies themselves as the OT also talked about the choice of environment in which the sensory processing intervention can be provided. She stated that sensory processing strategies could take place in the natural environment as well as within a sensory motor room. The OT believed that when children with ASC had very complex and involved sensory processing patterns this was likely to have an impact on the child's communication skills:

… what I've noticed is that those who have severe, severe sensory processing issues have difficulty to communicate as well

She perceived that sensory processing skills are underlying skills necessary to support other skills including attention, organisation as well as movement and linked this to the skills which she stated are necessary for successful learning of AAC systems. This is illustrated in this quote:

I think the sensory issues affect attention, sensory organisation will help also with eye hand co-ordination with visual attention so these are all interlinked: these are all needed in order to access a device properly.

She specifically stated that sensory motor difficulties impact learning functional skills which in her opinion included learning to use AAC systems.

Yes it (sensory motor difficulties) affects the use of a communication device or another communication system because you need to use your body so yes I think there is a relationship.

For some children with sensory processing difficulties the OT felt that her input would be necessary to support learning to use the AAC system depending on the nature and severity of the difficulty thus emphasising that this depends on the individual child. While the OT was aware of limited published research on the use of sensory processing interventions within the field of AAC, she indicated a possibility that a child with ASC might benefit from a combination of AAC and sensory processing interventions. The quote below illustrates how the sensory processing interventions were individualised for the four children who took part in Study 2 all of whom had sensory processing difficulties as well as ASC:

I think for all of them it was a very positive result, some of them [emm] were okay by providing them strategies within the, within the clinic room,

they didn't need major adaptations, they just needed adaptations to the environment and they responded very well. Others needed a lot of intervention within the sensory motor room but we could see that this really helped to improve their attention, to be able to [emm] identify, communicate, start to notice their environment much more and even were much more organised then in order to be able to cope with [emm] communicating using the device.

She also spoke about the two children in Study 1 who did not reach criterion. Specifically, the quote below refers to the impact of sensory processing difficulty implying that with greater severity of disorganisation there is a greater possibility that for the child, meeting sensory needs takes precedence over other activities. For these children, the OT considered that due to the sensory difficulties which were present it was not possible for them to learn to use the AAC device:

I think the criteria were not reached because of the state of organisation of those particular children because they were too much disorganised…trying to meet their sensory needs.

Theme 2: Child-clinician bonds are important

This theme was focussed on the importance of the clinician forming a bond with the child during the intervention process. The topic of **child-clinician bonding** was another thread which was quite prominent in the data and represents a topic which could potentially be of relevance when considering AAC intervention outcomes. This theme encompassed the OT's views on the importance of the clinician bonding with the child during interventions. Furthermore, it included her opinion of how she feels that this happens during interventions. While talking about the provision of sensory processing interventions, the OT spoke about the need for the clinician to be flexible in her therapeutic approach in order to form a bond with the child and this was tied in with the need to know how to 'use the self', a concept typically referred to within the occupational therapy profession:

…another strategy…you have to use mainly, is being [emm] flexible in your therapeutic [approach]…you have to know how adapt the use of yourself therapeutically with that child

The OT talked about forming a bond as a foundation to supporting the child to communicate. This is illustrated in the quote below, in which she perceived that giving the child what is needed from a sensory perspective will in turn help the child to form this bond with the clinician. In the OT's opinion, this could lead to greater interaction between the clinician and child: and this was likely to lead to increased motivation to communicate which then further supports the child to communicate:

…that when you really go [emm] with them and you give them what they need (sensory needs) and they like it, they show you back a connection, they connect with you, they do eye contact, they laugh with you, and they want you, and they will come for you, so I think that helps the communication and that they want to communicate.

The importance of providing the necessary sensory input as a precursor to forming the child-clinician bond was also referred to. The OT perceived that forming a bond could be supported by the provision of sensory processing interventions tailored to the specific child. In the quote below, the OT referred to other communicative skills which are positively impacted once a bond is formed. Here she referred to nonverbal skills including social skills, and that once this bond is formed, the child may recognise the need for the use of an AAC system:

I think working and giving them the necessary input enables them to connect with you and thus to really communicate with you so I think that helped with the social skills, the nonverbals I think, that helped them to improve the nonverbal skills and obviously identify why they need to use

something else to communicate rather than their their normal gestures or everything that they use

In order to support the formation of the bond, the OT made a reference to how the child's arousal levels affected her ability to bond with the child and therefore she needed to adapt her therapeutic self. The quote below is an example of how she adapts herself for a low arousal child (hypo-reactive) to ensure that she can bond with him:

If the child is low arousal maybe you use your voice and how you use your voice, intonation in your voice making it more animated in order to get that child more alert.

On the other hand she described how she uses a different set of strategies with a child who is over aroused (hyper-reactive sensory pattern):

If you have someone who is more agitated, more...you need to use a calmer voice, more rhythmical voice in order to help him to calm down.

Apart from the use of the clinician's communication skills, the OT also stated that she matches her energy levels to that of the child to support the process of forming a bond:

…*sometimes even your energy levels you have to match the child's and get him back to where you need him to be…*

Forming a bond was considered to be important as in doing so the OT was able to support the child to make progress within interventions. Such a bond was therefore viewed by the OT as the first step in the intervention process:

…it's a process I think, first getting the child to interact with you, to communicate with you, to have [like] that therapeutic relationship so that you can move him from one level to the other…

Although most of the references made in relation to forming a bond with the child were in relation to the use of sensory processing interventions, the OT made a specific reference which connected the formation of a bond to AAC interventions. In the quote below, the use of an AAC device is described as a way to further strengthen the bond between the child and clinician. In the OT's opinion, the AAC device was viewed as a necessity to support the formation of a true bond between herself and the child:

…if you don't have a system to communicate with him I think it's like doing a thing but not really gaining that relationship with the child. I think having then implemented an AAC device in the session it gives the child the opportunity to connect with the therapist much more

Theme 3: Ways to improve AAC intervention outcomes

The final theme centred on the OT's thoughts on possible ways in which AAC intervention outcomes could be improved when working with children with a diagnosis of ASC. The OT was particularly interested in children with a diagnosis of ASC and co-existing sensory processing difficulties. This theme, therefore, has a strong emphasis on sensory processing as an avenue for future exploration within the realm of AAC interventions. It consists of two subthemes: ***The impact of sensory processing difficulties on learning to use AAC*** and ***Collaborating to improve AAC outcomes***. These are discussed in turn below.

In the subtheme which focussed on the **impact of sensory processing difficulties on learning to use AAC** the OT stated that it was important to understand how sensory processing difficulties might impact AAC outcomes. Although the OT acknowledged the lack of research in the area of AAC and

sensory processing she was convinced that there was a relationship between sensory processing difficulties and communication which would likely impact learning to use the AAC device:

> *Yes it affects the use of a communication device or another communication system because you need to use your body so yes I think there is a relationship (between sensory processing difficulties and learning to use an AAC device).*

The OT stated that she had observed that the sensory processing pattern of hypo-reactivity and sensory discrimination difficulty were more likely to require her input within the provision of AAC interventions.

> *From what I observed, my hypotheses is that certain, those children who have poor registration (hypo-reactivity) and or discrimination problems were the most, the children had difficulty to learn to use the AAC device…*

Although the OT felt that certain kinds of sensory processing difficulties were more likely to negatively impact AAC intervention outcomes she acknowledged that there was a need for research in the area:

> *…we need to base it on more [emm] research so that to see if these patterns are actually correlating with children who have communication difficulties or difficulty to learn to use [emm] communication devices.*

According to the OT, an understanding of how differential patterns of sensory processing might impact learning to use an AAC device, would provide information for the SLT to be able to identify which children were likely to have the most difficulty learning to use an AAC device. This was considered important as in the OT's opinion, without some kind of sensory processing interventions some children with ASC were likely to continue to struggle with learning to use an AAC device:

…these children are the children that if you're not going to put sensory based interventions in place they're still going to have problems with the use of the AAC device…

The OT stated that a greater understanding of how sensory processing patterns could impact learning to use an AAC device would be useful as it would support clinicians to identify which services are required, e.g., a SLT or perhaps a combination of a SLT and an OT:

…you can identify those students that would need the input of an OT together with a speech therapist…for the speech therapist I think it would be good information that they would know hmm in these cases I think I need to work with an OT much more and maybe even ask where possible to work together…

The other subtheme within the theme ***Ways to improve AAC intervention outcomes*** was centred on the idea that ***Collaborating to improve AAC outcomes*** could be a consideration for the future. In view of the previous subtheme which questioned whether sensory processing patterns should be considered in AAC interventions, it was natural to also consider how this might happen and the collaboration between the SLT and OT professions that would be required to achieve this.

The OT talked about sensory processing interventions designed to improve sensory motor skills being combined with AAC interventions. The quote below illustrates that she feels that once sensory needs are met, learning to use an AAC device will start to be positively impacted:

I think so because what I am seeing is that they have sensory motor issues and motor…that is affecting the access of the device and when you try to, from my observations, when you manage and meet the needs of the

children try to improve their motor skills then you have improvement in the use of the device.

The OT was keen for sensory processing difficulties to be considered at the outset of the intervention. In this way, the intervention targeting sensory processing difficulties was meshed with the AAC intervention:

… implementing sensory strategies immediately within their sessions and while they are learning to use communication devices as well so that it would be part of the treatment so you're working on their sensory processing while implementing [emm] the AAC.

In the course of the interview, the OT expressed reasons as to why sensory processing interventions need to be considered when providing AAC interventions. Ultimately, however, the main reason was the need to see improved outcomes when providing AAC interventions:

I think for those children who have really severe sensory issues, I think working with giving them the necessary input in order to organise themselves is very important be- in order to see results towards using the AAC system.

The OT questioned whether utilising the two interventions together could lead to increased efficiency in service delivery when compared to typical AAC interventions. One outcome in providing interventions in this was could be less sessions over the long term:

…you have to see… how efficient it is in children getting [emm] [emm] actually learning their AAC. Is it this way they learn the AAC fast or is it the way we're doing it normally? How does it compare?

She was particularly interested in achieving the desired goals in a shorter timeframe. She was of the opinion that implementing AAC interventions with sensory processing interventions from the outset could be preferable in situations when the assessment indicated that the sensory processing difficulties could impact progress in AAC interventions. The following quote is an example of when the OT stated that there were times that the SLT was taking time to make progress with AAC interventions and that when sensory processing interventions were implemented they resulted in progress in the learning of AAC devices thus implying that there was a need to consider the child's sensory needs at the outset and not when goals are not being achieved:

> *Sometimes I heard [emm] speech therapists saying they have worked on something for a long time and they haven't achieved it, then once you implement sensory based strategies you achieve it much faster.*

In considering the four children who participated in Study 2, the OT stated that she had observed improvements in skills which in her opinion were important for learning to use the AAC device:

> *this (sensory processing intervention) really helped to improve their attention, to be able to [emm] identify, communicate, start to notice their environment much more and even were much more organised then in order to be able to cope with [emm] communicating using the device.*

When talking about how AAC interventions take into account the child's sensory processing needs, the OT noted that two of the children in Study 2 needed environmental adaptations, while the other two required more specialised interventions in a sensory motor room. For children who require environmental strategies, the OT stated there were times when she was not directly needed and that the SLT could be successfully guided on how to carry out certain strategies themselves:

I've been working with other speech therapists who I've given some recommendations like I give parents and I like give, I give teachers and they can implement them during their session and they have, like, some of them, like replied back that they had success by putting in strategies.

She also stated, however, that there are some complex cases which specifically required OT input, such as ASI or similar sensory processing interventions. This, in her opinion would require specific training in the area which would need an OT:

…but obviously when you have, like, children who have like, really need treatment within SI [emm] I think then [emm] they, an occupational therapist needs to be involved.

The OT was an experienced transdisciplinary professional already working with an SLT on a regular basis. She perceived the notion of both professionals working together in order to combine sensory processing interventions with AAC interventions as a mutually beneficial relationship which would be a supportive one for both therapists and child. She gave an example of how the two professionals might collaborate in a sensory motor room in order to support the child to achieve organisation which supports him to respond positively to the AAC interventions. In the quote below, collaboration between the SLT and OT is considered positive although role boundaries are also present:

Probably I think it would be best to have two professionals doing it together so that the session is being run by two therapists. You have the OT who is [emm] obviously putting up the equipment and working with the child and then the speech therapist who's seeing the opportunities in order and seeing which language they need and which words are important in order to be taught.

5.4 Discussion

The interview with the OT was carried out to explore her opinion on how interventions targeting learning to use AAC systems should be implemented with children who have a diagnosis of ASC.

The first aim of conducting the interview with the OT was to explore her perceptions of the two different displays: the VSD and grid display. During the interview, many issues were discussed in relation to the implementation of AAC with children with ASC. These included the use of specific teaching strategies, the teaching context, the notion of fun and play but no mention was made of the actual AAC hardware itself apart from noting that some children may need additional support in the form of keyguards to support increased accuracy when touching the VOCA display. She acknowledged that children with ASC progress differently in their learning of AAC systems but attributed this to other differences such as sensory processing, and not to any difference in the organisation of the vocabulary on the VOCA display. The OT conceded, however, that the choice of vocabulary layout may be important if a child has difficulties in the area of visual scanning. In this scenario the OT perceived that a grid display might in some instances better support learning. This corresponded to parental opinion in Study 2. Once asked directly of her opinion of the visual displays, however, she stated on more than one occasion that she did not feel that this was the most important factor in the child's progress when it comes to learning to use an AAC device. This converged with the results of Studies 1 and 2 which were carried out prior to the OT interview and which did not indicate that there was an advantage in the use of one display over another. This then raises the question: if the choice of visual display does not differentially impact on progress, what factors, in the OT's opinion do?

The second aim of this study was to explore the OT's role within the provision of AAC interventions. The OT's responses provided some food for thought on factors which might be useful to consider when planning AAC interventions for young

children with a diagnosis of ASC. She viewed the need to ensure that sensory processing was at optimal levels for learning to take place. This is in keeping with published literature from the area of sensory processing, for example, Schooling et al. (2012). The OT, however, extended this idea to include learning to use an AAC device. In stating that sensory processing could be an underlying skill for learning to use an AAC device, consideration must be given to the role of the OT within the process of teaching a child with ASC to use a VOCA.

The process of supporting a child to achieve the optimal arousal level was built on two foundations. Firstly, the OT perceived the need to establish a bond with the child as integral to her interventions. Secondly, she perceived that the heterogeneity of children with ASC impacted the interventions she provided. These two ideas are to a certain extent linked as she considered the ability to form a bond as linked to the kind of sensory processing difficulty which the child presented with. The way the clinician bonds with the child then differs according to each child (Watson et al., 2011). The importance placed on the ability to bond with the child is particularly interesting as the OT was extremely focussed on this concept as the basis for progress when providing sensory processing interventions. Schaaf and Mailloux (2015) describe the creation of a therapeutic alliance as one of the contextual elements necessary to implement ASI. According to the authors, the objective of the therapeutic alliance is the fostering of a trust relationship with the child so that the child will then be a willing participant in new activities and during play. Such a concept raises questions about if being able to bond with a child could also be considered as a necessity for successful implementation of AAC interventions. If so, it would therefore be a shared concept in both AAC interventions and sensory processing interventions.

In an interview, when considering how to make AAC successful for children with ASC, Ogletree (2013) talked about the importance of communication partner communication styles and how this can influence the ability to bond with the child thus it would seem that the OT's focus on forming bonds with the child is not

exclusive to occupational therapy. Both Ogletree (2013) and the OT support the idea that it is the adult communication partner who needs to be flexible in finding a way to connect with the child. The OT discussed how she communicates differently with the child according to the sensory processing pattern thus acknowledging the differences which can be found in this group of children whilst also stating that the onus is on her to find a way to connect with the child. This is consistent with Watson et al. (2011) who concluded that when working with children with ASC, different intervention strategies may be required, according to the child's sensory processing pattern. Within the SLT literature, there has been a suggestion that therapeutic outcomes may be impacted by the ability of the SLT to form a therapeutic alliance, for example, in Ebert and Kohnert's (2010) work, although no published research was found concerning how clinicians connect with children with ASC during AAC interventions.

The OT suggested that the use of behaviourist strategies such as physical prompting, fading, task analysis etc. that were used in Studies 1 and 2 were appropriate ways to teach AAC use to children with ASC but she was also keen on the use of naturalistic situations for teaching AAC. The use of a combined approach in which ABA principles are embedded in more naturalistic contexts is supported by the literature (Logan et al., 2017). Kaiser and Wright (2013) described how the use of behavioural strategies can be combined with activities which encourage play and engagement to support children to learn functional communication skills. Naturalistic settings were utilised in the two previous intervention studies as play situations were set up in a clinic room but the OT was also considering a sensory motor room as a setting for teaching AAC use. The advantages of such a setting could be the emphasis on gross motor movement which is natural in this environment. Regardless as to which setting is utilised for AAC interventions, the most important element from the OT's point of view was to set up an atmosphere of fun through play which supports the forming of a connection with the child. Kaiser and Wright (2013) state that communication is facilitated through play and shared engagement, and this is more likely to be

successful if the child's lead is followed and the environment is arranged to extend the interaction. Such an atmosphere provides motivation and communication opportunities leading to a greater possibility that the child will request enjoyable activities and objects.

As described by the OT, assessment results are integrated to determine the nature and type of sensory processing difficulty. Watling and Hauer (2015) state that a pre-intervention evaluation of sensory processing is recommended best practice for all uses of sensory processing interventions so that strategies to be used can be customised. Sensory processing interventions in a sensory motor room may not be necessary for all children with sensory processing difficulties and the OT stated that for some children the use of environmental modifications provided in a clinic setting may be adequate. She went on to suggest the possibility that such modifications may be carried out by an SLT with OT guidance. The provision of sensory input embedded in daily tasks to modulate arousal which is combined with environmental modifications to enable participation is suggested by Ashburner et al. (2014). This is consistent with International Classification of Functioning, Disability and Health views which shifts the attention away from the child to the activities and contexts in which child is expected to participate in and is also described by Dunn et al. (2016). The OT maintained that for some children, however, it would be necessary to provide interventions in a sensory motor room and that SPIs would be needed in that setting.

While the assessment of sensory processing skills as part of an AAC assessment for children with ASC is referred to by Iacono and Caithness (2009) there is a paucity of literature on how the outcome of assessment might impact on the choice of AAC interventions. Such assessments could be utilised to support the clinician to understand how best to bond with a child with ASC as groundwork for the successful implementation of AAC interventions. Sensory motor skills support carrying out functional activities and in order for learning and co-ordinated movement to occur there must be integration of incoming sensory stimuli (Bundy

et al., 2002). If AAC use is considered to be an activity which requires both learning and the use of co-ordinated movements then it appears logical that AAC interventions should in some way be linked to information about the child which is provided by sensory processing assessments and the key may be in understanding the child's sensory processing pattern.

The OT perceived that the presence of greater communication challenges and difficulties learning to use AAC systems were possibly linked to specific sensory processing patterns: those who present with discrimination difficulties, and/or the presence of a hypo-reactive pattern. This is consistent with research, for example, Watson et al. (2011) who have provided some initial evidence that a hypo-reactive sensory pattern is more likely to impact on language and social communication in children with ASC. As Watson et al.'s (2011) research focussed on sensory modulation difficulties it did not extend to children with ASC who have sensory discrimination difficulties. It has, however, been suggested that research on the impact of sensory discrimination difficulties in children with ASC also needs investigation (DeBoth and Reynolds, 2017). At this stage, importantly, it is not known how sensory processing difficulties impact on learning to use AAC systems per se. If there was published research on how sensory processing difficulties affect learning to use AAC systems this might impact on how AAC interventions are selected and then provided.

The OT suggested that children with ASC presenting with certain kinds of sensory processing patterns, for example, a hypo-reactive pattern, are likely to continue to struggle to learn to use AAC if their sensory processing needs are not addressed. Including an OT in the AAC intervention team for these children therefore becomes a necessity because the OT is uniquely trained to understand and provide interventions that tackle the issue of sensory processing. Sensory processing underlies all kinds of learning and the use of AAC is one kind. Attention and visual skills are all underlying skills to learn to use an AAC device but it is sensory processing which underlies these (Miller et al., 2001). For children with

sensory processing patterns who are likely to have communication difficulties the selection of interventions, in the early stages, may need to be more carefully thought through together, by both an OT and a SLT thus supporting collaboration between the two professions in the early stages. DeBoth and Reynolds (2017) have questioned whether different sensory subtypes might be responsible for differing responses in intervention and have suggested that if sensory subtypes were examined in greater detail this might better inform treatment pathways. The OT suggested examples of treatment pathways for AAC interventions e.g., AAC intervention after sensory processing interventions in a sensory motor room. On the other hand, she suggested that for other sensory processing patterns, AAC interventions may be implemented in a clinic setting with environmental modifications. These possible treatment pathways are not surprising as they echo the interventions provided to the participants in Study 2. The OT does, however, suggest another possibility, that of integrating the sensory processing interventions and AAC interventions to one setting, the sensory motor room. She suggests the possibility of providing both at the same time so that the AAC intervention is meshed with the sensory processing intervention. In all of these potential scenarios sensory interventions are integrated with communication strategies to support sensory differences (Anzalone and Williamson, 2000).

Limitations

This study presents with some limitations: namely that the OT was involved in the provision of interventions in Studies 1 and 2 and therefore her opinions may, to a certain extent have been influenced by the researcher who was also involved in these studies. Furthermore, the researcher's theoretical knowledge may have biased the analysis (Greenhalgh and Taylor, 1997a).

Future research directions

Despite the limitations, the interview data provides food for thought for possible avenues for further research: one of the initial aims of this study. The OT felt that further research could be carried out in two areas. Firstly she was keen to further

investigate the impact of differing sensory processing patterns on learning to use AAC systems. Secondly, the OT suggested that it would be interesting to compare the location of AAC interventions. The interview with the OT, however, also brought into focus the importance of being able to connect with the child as a foundation for both sensory processing interventions and AAC interventions and this could be considered for future research possibilities when investigating how to improve clinical outcomes for children with ASC who require AAC interventions.

Plan for Study 4

Study 4 was planned as a mixed methods study which provided further data on how sensory processing patterns impact learning to use AAC systems whilst providing information on how clinicians bond with children with ASC during the AAC intervention process. As the evidence from Studies 1 and 2 suggested a minimal difference in display layouts, the grid display was chosen for Study 4. In view of the published literature which has indicated that the VSD could potentially limit the child in the longer term (Abbott and McBride, 2014), it was decided to provide intervention in the grid display only. This is because it has been suggested that if the child is to move on towards becoming an independent communicator, a system of vocabulary is required which would support the child to build sentences in a generative fashion (Abbott and McBride, 2014).

Up to this point, the sensory processing abilities of eight children in Studies 1 and 2 were assessed. In the next phase of this project a further four children with ASC and sensory processing difficulties were recruited providing further information on how this could impact their learning of AAC systems. Furthermore, there was a focus on how clinicians communicate with the participants in the final study in order to begin to consider how clinicians bond with children with ASC when providing AAC interventions.

Chapter 6. Study 4

A mixed methods study: A Single Case Experimental Design designed to teach children with Autism Spectrum Condition to communicate using a voice output communication aid, and a focus group to explore clinicians' opinions of how AAC interventions are provided

Introduction

In the present thesis, two intervention studies, (Studies 1 and 2) were carried out which focused on teaching children with a diagnosis of autism spectrum condition (ASC) to request using a voice output communication aid (VOCA). The focus of both of these studies was to compare the effects on learning to request with two different ways of representing vocabulary on a display, a grid display and a visual scene display (VSD).

In the first study, two participants achieved criterion within the intervention phase while the other two participants did not achieve criterion. Analysis of the results indicated that this did not appear to be related to the visual displays as the performance was similar for both. When the inherent participant characteristics were further examined for possible influencing factors, it emerged that the differing sensory processing patterns, together with adaptive functioning and current levels of receptive language could be important factors in how these children with ASC progressed in their learning of how to use a VOCA to make requests. This was concluded because the two participants who achieved criterion had minimal sensory processing difficulties, higher levels of adaptive functioning, early communication skills and receptive language at the outset of the study.

For the second intervention study (Study 2), it was decided to deliberately recruit children with ASC and co-existing sensory processing difficulties. In this study, all four children were able to achieve criterion in at least one display although different rates of progress were evident. For three of the children this did not

appear to be related to how the vocabulary was organised on the display of the VOCA, but may have been related to other child characteristics such as the differing sensory processing patterns evident in the sample. Furthermore, the parents did not perceive any difference between the two visual displays in terms of the effects on their child's requesting although they felt that the VSD could result in greater errors.

Following the second intervention study, a qualitative study was implemented (Study 3). In this study, the occupational therapist (OT) who took part in the implementation of intervention in Studies 1 and 2 was interviewed. The analysed interview data indicated several themes of interest, one of which was a theme which concerned how therapists bond with children with ASC when providing interventions. The OT talked about how important it was for her to adapt her communication skills when working with children and she stated that this was done according to their differing sensory processing patterns and that this was an important basis for her interventions.

The conclusions drawn from the interview with the OT are important as they provide a potential contribution to answering the original research question for this PhD. This question specifically relates to the decision-making process of how augmentative and alternative communication (AAC) interventions are chosen for children with ASC. Initially, the PhD focused on the display decisions as one element of the decision-making process. Child characteristics were considered as possible factors which might influence choosing one display over another for a particular child but the first two intervention studies did not provide enough evidence for a clinician to select one visual display over another. The interview data however, potentially sheds new light on the decision-making process. This data suggests that child characteristics in children with ASC, in particular sensory processing patterns may impact on how the clinician interacts with the child. If this is so, the clinician must also make a decision about how s/he will communicate with the child in the AAC intervention process.

In view of the preceding studies, it was decided to design a mixed methods study which would systematically replicate the intervention provided in Studies 1 and 2 with the addition of a qualitative strand. The overarching methodology for this research design is discussed in Section 2.8. The qualitative strand, a focus group was utilised to provide data which would enrich the data from the quantitative intervention strand (Creswell and Clark, 2011). The other strand, the SCED, was a systematic replication of Studies 1 and 2 although intervention was provided in the grid display only. This was decided because the previous studies did not provide sufficient evidence that one display provided any great advantage over another. This was corroborated by both parental and OT opinion. The grid display was specifically chosen for intervention in the SCED in Study 4 because of its potential to provide access to more complex language in the longer term (Abbott and McBride, 2014).

6.1 Methods/Design

This study was a mixed methods intervention design which included two strands (Creswell and Plano Clark, 2018). Specifically, the first strand was predominantly a quantitative strand which included a single case experimental design (SCED) which provided the quantitative data and is therefore referred to as the SCED strand. In this study, intervention was provided to four participants in a multiple-probe design. As social validity was also included to assess parental opinion of the social importance of the effects of the SCED some qualitative analysis was also utilised within this strand thus it is acknowledged that this strand is considered to be mixed methods (Richards, 2018). The SCED strand was linked to a focus group in which three clinicians with experience in the field of AAC participated and which served as the qualitative strand. The data collection for the focus group was carried out after the intervention was carried out in the SCED. A detailed flow chart of the overall design is displayed in Figure 6.1. Methods and results for each of the strands are described separately.

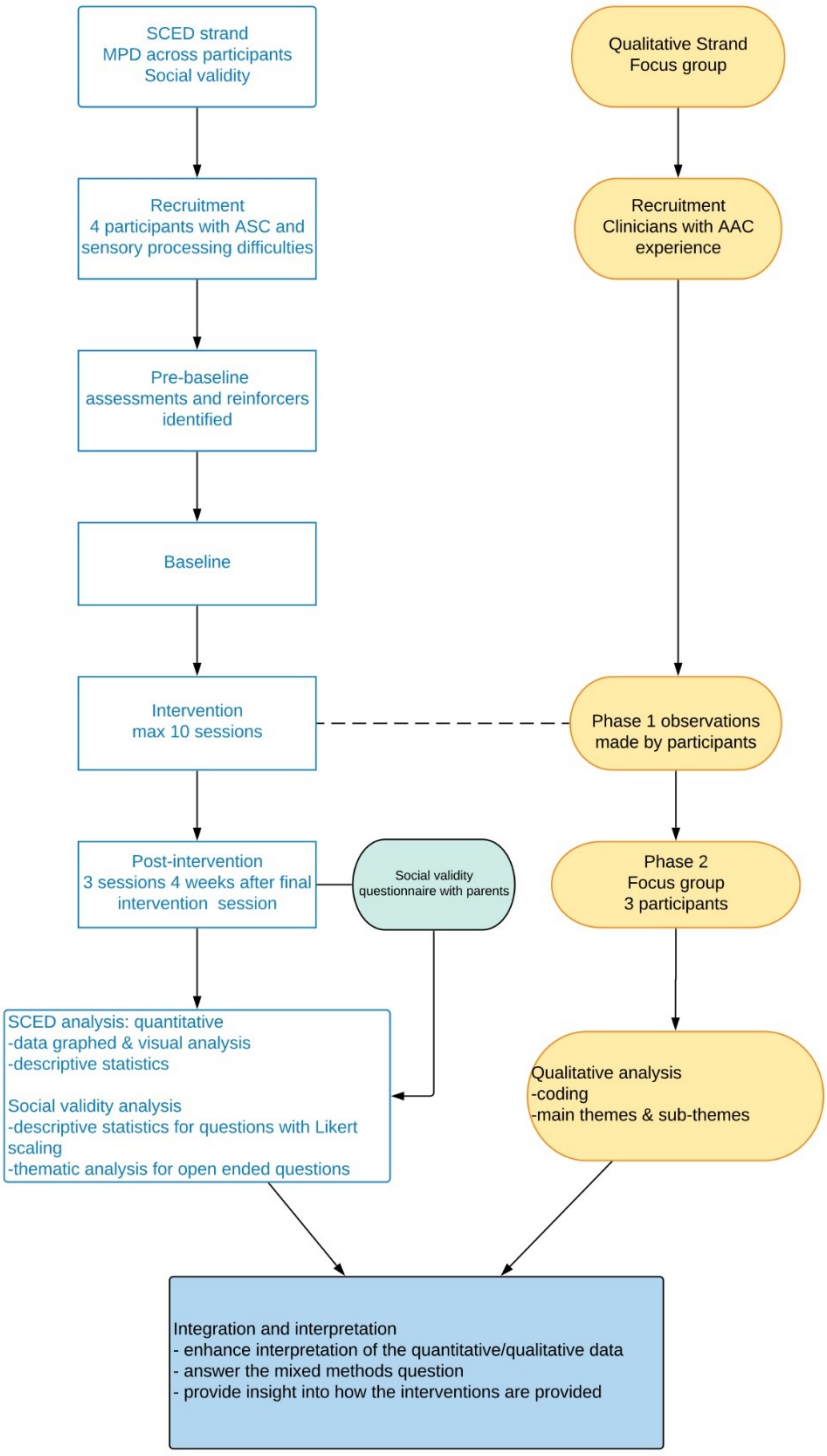

Figure 6.1 Study 4 design

6.2 Purpose Statement

The first aim of this mixed methods study was to systematically replicate Studies 1 and 2 by teaching four more children with a diagnosis of ASC and co-existing sensory processing difficulties to request desired objects and activities using a VOCA. The second aim of this study was to explore how differing sensory processing patterns impact on the learning process. The third aim was to determine whether the clinician responds differently to these sensory processing patterns when carrying out interventions and if so, in what ways. A mixed methods intervention design was used in which focus group data was collected after the intervention phase of the SCED. The quantitative data from the SCED was used to determine the impact of the introduction of an intervention designed to teach requesting to four children with ASC and co-existing sensory processing difficulties to use a VOCA for requesting at Access to Communication and Technology Unit (ACTU) in Malta. This data was supplemented by data from the parents of participants who took part in the SCED using assessment of social validity which was both quantitative and qualitative in nature. The focus group which generated the qualitative data consisted of clinicians who were currently working in the field of AAC and was used to provide insight into how the intervention was implemented in the SCED by the clinicians (Ivankova and Kawamura, 2010). As the collection of qualitative data took place after the intervention phase of the SCED, the design is referred to as an explanatory sequential design. The qualitative results were combined with the SCED outcome results in the discussion (Section 6.9) to provide a more complete understanding of how clinicians provide AAC interventions to children with ASC and co-existing sensory processing difficulties (Creswell and Clark, 2011; Creswell and Clark, 2018).

6.3 Research Questions

1. How does severity of sensory processing difficulty impact on learning to use a VOCA to request?

2. How do discrete sensory processing patterns impact on learning to request using a VOCA?
3. What are clinicians' perspectives of how specialist AAC clinicians communicate during the provision of AAC interventions to children with a diagnosis of ASC and co-existing sensory processing difficulty?
4. In what way do the focus group data, reporting clinicians' perspectives of how specialist AAC clinicians communicate during AAC interventions, help to explain the quantitative results of the SCED implemented to teach children with ASC and sensory processing difficulty to learn to request with a VOCA?

6.4 Ethical approval and informed consent

Approval for the study was obtained from Ethics Committees at Manchester Metropolitan University and The University of Malta and from the Director of the Student Services Department and the Ministry of Education in Malta (Appendix 1).

For the SCED, a consent form giving permission for their children to take part in the study was given to parents (Appendix 2). Participants' consent was inferred from their assent to participate in the sessions. For the qualitative aspect of the study, consent was also obtained from the AAC clinicians (Appendix 2).

6.5 SCED study methods and analysis

6.5.1 Participants and recruitment

Four participants who met the following criteria were recruited from the ACTU waiting list:

a) Diagnosis of ASD from a psychologist independent to the study
b) Under age 6 years
c) Expressively non-verbal or less than 20 words which are used for functional communication.
d) Have a diagnosis of a co-existing sensory processing difficulty

A screening appointment was offered with both a speech and language therapist (SLT) and an OT. During the screening appointment it was confirmed that the child was minimally-verbal through parental report and assessment of the child's expressive communication during the session.

Exclusion criteria were that there were no auditory/visual impairments that would impact on learning to use the AAC system.

The parents of four potential participants were given an information letter and consent form in Maltese or English (depending on their choice) inviting them to voluntarily participate in the study (Appendix 2). All four families consented to participate. Once parental consent was gained, the following assessments were carried out by the SLT and/or OT with their children:

1. Autism Diagnostic Observation Scale-2 (ADOS-2): Module 1 (Lord et al., 2012)
2. Vineland Adaptive Behaviour Scales-2 (VABS-2; Sparrow et al., 2005)
3. McArthur-Bates Communicative Development Inventories-III (CDI-III): Words and Gestures (Fenson et al., 2007). Total Gestures section only administered.
4. Short Sensory Profile (SSP; McIntosh et al., 1999)

All child characteristics and the results of baseline measures are summarized in Table 6.1.

Table 6.1 Study 4: Summary of SCED participant characteristics

	Participant			
	Noah	James	Lee	Max
Age	5;08yrs	4;11yrs	5;03yrs	4;01yrs
Gender	Male	Male	Male	Male
Primary language	English	English	English	English
Secondary language	n/a	Maltese	n/a	Maltese
ADOS-2 comparison score	8	8	9	9
Level of autism related symptoms	High level autism-spectrum related symptoms	High level autism-spectrum related symptoms	High level autism-spectrum related symptoms	High level autism-spectrum related symptoms
Total gestures: Age Equivalent (CDI-III: Words and Gestures)	11mths	11mths	10mths	10-11mths
Description of expressive communication	Nonverbal. Able to point to request. Pushes adults to show what he is requesting. Gives objects to adults to request. Puts adults' hands on objects to request help. Pushes away undesired objects.	Nonverbal. Rarely initiates communication with others. Requests occasionally by reaching towards desired objects, does not look at the communication partner	Nonverbal. Puts adults' arm to what he wants to request. Tries to get what he wants himself.	Says one word 'no' on rare occasion. Puts adults' arm to what he wants to request. Tries to get what he wants himself. Screams, shouts & bites when he does not want to do something.
Prior experience of AAC	No history of AAC	PECS: Phase 3 achieved	No history of AAC	Working on PECS: Phase I not achieved
Receptive communication (Vineland-2)	Age Equivalent: 0;08yrs Adaptive level: Low	Age Equivalent: 1;01yrs Adaptive level: Low	Age Equivalent: 0;09yrs Adaptive level: Low	Age Equivalent: 1;0yrs Adaptive level: Low
Expressive communication (Vineland-2)	Age Equivalent: 0;04yrs Adaptive level: Low	Age Equivalent: 0;02yrs Adaptive level: Low	Age Equivalent: 0;05yrs Adaptive level: Low	Age Equivalent: 0;02yrs Adaptive level: Low
Written communication (Vineland-2)	Age Equivalent: 3;06yrs Adaptive level: Low	Age Equivalent: 4;0yrs Adaptive level: Adequate	Age Equivalent: 2;06yrs Adaptive level: Low	Age Equivalent: 3;06yrs Adaptive level: Adequate
Communication composite (Vineland-2)	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low

Gross Motor skills (Vineland 2)	Age Equivalent: 2;05yrs Adaptive level: Moderately Low	Age Equivalent: 3;03yrs Adaptive level: Moderately Low	Age Equivalent: 2;10yrs Adaptive level: Moderately Low	Age Equivalent: 3;03yrs Adaptive level: Adequate
Fine Motor skills (Vineland-2)	Age Equivalent: 1;03yrs Adaptive level: Moderately Low	Age Equivalent: 2;09yrs Adaptive level: Moderately Low	Age Equivalent: 2;10yrs Adaptive level: Low	Age Equivalent: 2;08yrs Adaptive level: Moderately Low
Motor Skills Composite (Vineland-2)	Adaptive level: Low	Adaptive level: Moderately low	Adaptive level: Moderately low	Adaptive level: Moderately low
Daily Living Composite (Vineland-2)	Adaptive level: Low	Adaptive level: Moderately Low	Adaptive level: Low	Adaptive level: Low
Socialisation composite (Vineland-2)	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low	Adaptive level: Low
Adaptive behaviour composite (Vineland-2)	Adaptive level: Low Standard Score: 37	Adaptive level: Low Standard Score: 64	Adaptive level: Low Standard Score: 42	Adaptive level: Low Standard Score: 60
SSP score	146 Probable difference	142 Probable difference	124 Definite difference	123 Definite difference
Classification				
	Hypo-reactive to sensory input	Sensory seeker	Fluctuates between Hypo- and Hyper-reactive to sensory input	Hyper-reactive to sensory input Postural sensory disorder
	Definite difference in 1 area: 1. Low energy/weak	Definite difference in 1 area: 1. Underesponsive/ seeks sensation	Definite difference in 3 areas: 1. Taste smell 2. Auditory filtering 3. Low energy/weak	Definite difference in 4 areas: 1. Tactile sensitivity 2. Taste smell 3. Underesponsiv e/ seeks sensation 4. Auditory filtering
	Probable difference in 1 area: 1. Tactile sensitivity	Probable difference in 4 areas: 1. Taste smell 2. Movement sensitivity 3. Auditory filtering 4. Visual/auditory sensitivity	Probable difference in 2 areas: 1. Tactile sensitivity 2. Underesponsi ve/ seeks sensation	Probable difference in 2 areas: 1. Movement sensitivity 2. Visual/auditory sensitivity

Educational Placement	Full time mainstream	Full time mainstream	3 days mainstream & 2 days specialised ASC educational placement	Full time mainstream

6.5.2 Setting and intervention context

All AAC intervention sessions were carried out in the ACTU clinic room as described in Study 1 (Section 3.2.2; Figure 3.1). All clinic room equipment not required for the intervention was stored away in boxes to ensure that the children were not distracted. As part of the intervention it was determined that some participants required sensory motor interventions in a room designed for this purpose prior to the session in the ACTU clinic room. The motor sensory room was situated close to the ACTU clinic room and was equipped with the necessary equipment to carry out these interventions (Figure 4.1). Details of each participant's sensory processing programme which outlines where these were carried out can be found in Section 6.5.8.1. Each participant was offered sessions in an individual context.

6.5.3 Materials

An iPad 4 encased in a Griffin Survivor case with iOS 10.2.1 software was used for all phases of the SCED in Study 4. The Scene and Heard® application (app) version 3.0 was used on the iPad as the AAC app to ensure continuity with protocols in Studies 1 and 2. Each participant's chosen reinforcers were identified in the pre-baseline phase. The display was configured to a grid display with 4 hotspots in a 2 x 2 cell layout programmed to emit a voice recording when activated (Figure 6.2). A boy of similar age made voice recordings in Maltese or English according to the participants' home language. The voice recording for each hotspot was the name of the reinforcer.

Figure 6.2 Example of the VOCA screen display configured for Max

6.5.4 Study Design

The study utilised a multiple probe design (MPD) across participants consisting of pre-baseline, baseline, intervention, and follow-up phases (Figure 6.3; Horner and Baer, 1978; Gast et al., 2014). The pre-baseline phase was used to identify reinforcers which could be used for the other phases of the study. All participants commenced baseline phase on the same day. Baseline probes were carried out once a week until the week prior to the commencement of intervention. In the week before intervention commenced each participant then attended for three baseline sessions. The MPD supported the sequential introduction of intervention so the fourth participant remained in baseline for the longest period. During the intervention phase the teaching protocol described in Study 1 was introduced to teach requesting of reinforcers using an iPad as a VOCA (Table 6.2). The

commencement of intervention was staggered across participants and therefore introduced one week apart to avoid long periods in baseline in the event that a participant did not make progress with the intervention (Gast et al., 2014). Each participant received a maximum of 10 sessions of intervention.

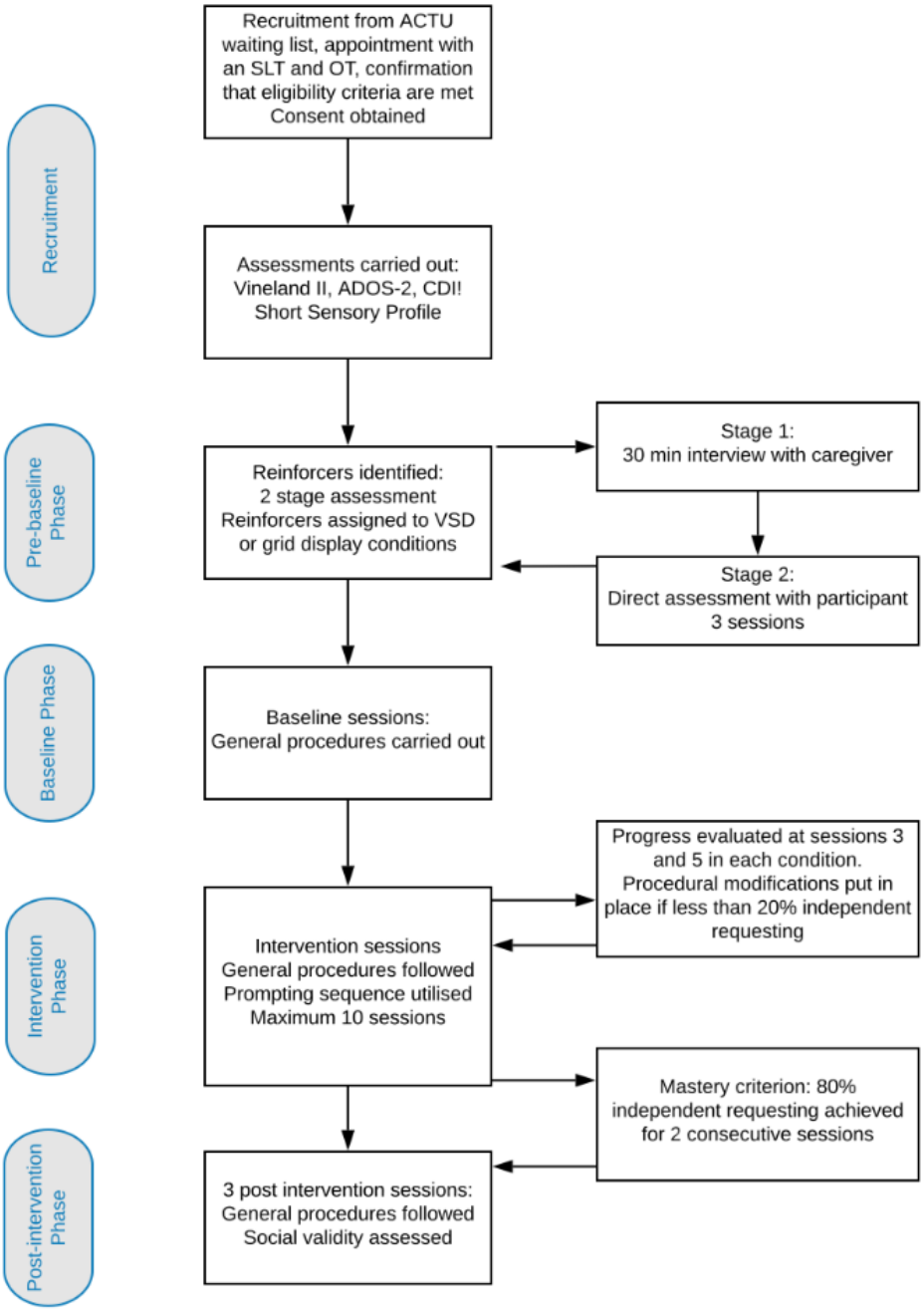

Figure 6.3 Study 4 phases: Quantitative strand within mixed methods study

6.5.5 Pre-baseline phase: Identification of reinforcers

Snacks and toys were identified for each participant using a 2 stage reinforcer assessment process during the pre-intervention phase (Figure 6.3; Kang et al., 2013; Stephenson, 2016). The identified reinforcers were used in the baseline, intervention, and post-intervention phases.

In Stage 1 a 30 minute caregiver interview adapted from Green et al. (2008; Appendix 3) was administered to the primary caregiver. The reinforcer assessment was an indirect assessment which supported the identification of snacks and toys that were suitable for the intervention phase of the research at ACTU. In Stage 2, the stimuli identified in Stage 1 were tested through a process of presentation to participants on three separate occasions over a period of 1-2 weeks (Graff and Ciccone, 2002). All stimuli identified were presented in two groups: snacks and toys (DeLeon and Iwata, 1996). Participants were encouraged to choose one item from each group. Once the item was chosen the participant was allowed to eat/drink it or play with it for a short time. Choices were then given until there were no items left to choose from. The order of choice was recorded by the researcher. Snacks and toys were then ranked separately using the formula (number of selections/number of offers) x 100%. Where possible, the top two toys and snacks were chosen as reinforcers for each child. This varied according to child and did not always mean two snacks and two toys (see Table 6.2).

Table 6.2 Study 4: Preferred reinforcers

Participant	***Reinforcers***
Noah	Toy animals 100%, flashing balls 42.9%, rubber blocks 25%, milk 25%
James	Fidget toys 60%, ball 50%, yoghurt 100%, almond drink 42.9%
Lee	Foam letter puzzle 37.5%, block puzzle 37.5%, sponge cake 42.9%, orange juice 37.5%
Max	Puzzle 75% , block puzzle 60%, yoghurt 42.9%, orange juice 25%

6.5.6 Response definitions, measurement and scoring procedures

Spontaneous requesting was the dependent variable for the study. This was defined as unsolicited picking up of the VOCA, stretching out towards the communication partner with the VOCA, and then touching a cell on the screen to activate the voice output to suggest a request for a reinforcer. Direct systematic observational recording (DSOR) was used to collect data on all requests for reinforcers for the duration of each session in all phases of the study (Ayres and Ledford, 2014). DSOR involved observing and coding the requesting behaviour as it occurred in the session (Appendix 4). The percentage of independent responding was calculated post-hoc for each session using the following formula: independent requests/ (independent requests + prompted requests + incorrect requests) x 100. Mastery criterion was considered achieved when the participant spontaneously requested on 80% of trials for two consecutive sessions.

6.5.7 Session schedule

Each participant attended for three sessions of 20 minutes duration on a weekly basis for the duration of the study. Each session was scheduled at the same time of the day and on the same days per week for each participant.

6.5.8 Procedures

6.5.8.1 *General procedures*.

General procedures were used across all study phases. In the waiting room, the participant was shown a photograph of the VOCA screen display with their reinforcers. The researcher pointed to the items in the photo while saying "today you can ask for these things". If the participant received sensory processing interventions prior to the intervention session, the participant was shown the photo of the VOCA screen display in the sensory motor room after the sensory motor interventions were concluded: to support understanding of the next activity.

The reinforcers identified for each participant were made available on a shelf which was in sight but which could not be physically accessed by the participants.

On entering the room, the participant was directed to the items on the shelf and asked "what do you want to do?". The participant was expected to make a selection by pointing, reaching or using the VOCA. If a choice was not made within 10 seconds, two reinforcers were selected by the researcher and offered to the participant to make a choice. If no choice was made within a further 10 seconds one of the reinforcers was replaced with another. This continued until all four reinforcers were offered. If no selection was made after all four reinforcers were offered the plan was to terminate the session. Once a reinforcer was selected, naturalistic strategies embedded in play and snack routines were used to create opportunities for requesting (Olive et al., 2007; Halle et al., 1981). Reinforcers were provided immediately and the requested reinforcer was verbally stated by the clinician. Participants were able to request as frequently as desired during a 20 minute period. All requests were recorded during the session by the communication partner on data sheets designed for the study (Appendix 4).

As all the participants had sensory processing difficulties, a sensory intervention programme was initiated for each child by an OT as an AAC intervention adjunct. The sensory processing programme was implemented for all phases of the study including baseline and post-intervention phases. The sensory strategies used varied according to each child's sensory needs as determined by the results of the Short Sensory Profile which was administered in the recruitment phase. These assessment results were utilised to plan a sensory intervention programme in conjunction with informal observations of the child. Table 6.3 includes a summary of activities and the location where they were carried out for each participant. A detailed programme of activities selected to support sensory processing for each participant can be found in Appendix 11. All participants received sensory processing interventions in the ACTU clinic and/or sensory motor room during all study phases. For some participants this entailed a session in the sensory motor room before the AAC intervention session with environmental modifications made inside the AAC clinic room during the study sessions, whilst for Max the sensory

motor interventions were provided within the AAC intervention session only e.g., providing him with a gym ball to sit on during the AAC intervention

Table 6.3 Study 4: Summary of participants' sensory motor programme

Participant	***Sensory motor activities***	***Place/time where sensory motor programme was carried out***
Noah	Environmental modifications Proprioceptive, linear and circular vestibular and tactile activities	Environmental modifications during all study sessions in the ACTU clinic room Sensory motor room access prior to all AAC study sessions
James	Environmental modifications Linear, vestibular and proprioceptive activities	Environmental modifications during all study sessions in the ACTU clinic room Sensory motor room access prior to all AAC study sessions
Lee	Environmental modifications Proprioceptive activities: linear vestibular input	Environmental modifications during all study sessions in the ACTU clinic room Sensory motor room access prior to all AAC study sessions
Max	Environmental modifications Vestibular movement in the form of movement breaks	Environmental modifications during all study sessions in the ACTU clinic room

6.5.8.2 *Baseline/Probe phase*

The baseline/baseline-probe phase was designed to collect data on the participants' current spontaneous requesting skills using the VOCA. The effects of the treatment implemented in the intervention phase could then be measured against this probe data. The VOCA was available within reach of the participants during all baseline sessions which were of 20 minutes duration. The participants were not directed to it or taught how to use it for requesting. All attempts to request reinforcers using pointing, reaching or vocalisations were honoured by the researcher by providing immediate access to the item.

6.5.8.3 *Intervention*

The intervention sessions were identical to baseline sessions except for the introduction of the independent variable which consisted of the teaching protocol as described in Studies 1 and 2 (Table 3.3). The protocol was introduced to teach each participant to request independently using the VOCA. The phrase "let's tidy up and choose something else" if the child requested the same reinforcer for longer than 10 minutes was used to ensure that at least two different reinforcers were requested per session. If a child played with the same reinforcer for more than 30 seconds, a natural cue such as "I have more animals!" was used to encourage the child to request again.

If the participant requested a different item from the current reinforcer e.g., if the child was eating a biscuit, but touched the shapes visual on the VOCA, the correspondence check described in Study 1 was carried out to ensure that the participant was indeed requesting a new item (Figure 3.5). If there was no correspondence an error correction sequence was initiated (Figure 3.6).

Each participant received a maximum of 10 sessions in each condition. Intervention sessions were terminated once criterion was achieved.

6.5.8.4 Procedural modifications

As a SCED is a dynamic research method, it is possible to make modifications to the intervention procedure for an individual who is not responding to the intervention (Gast and Ledford, 2014). All participants with the exception of Lee made progress with the intervention but as Lee's progress was variable, it was necessary to put procedural modifications in place to support him to achieve criterion.

From the outset of intervention, Lee refused to touch inside the hotspot (the red border around each photo of his reinforcer). Due to this, the red border was removed for intervention session 3 but it then became clear that the border was

not the issue. It appeared that he did not want to touch the visual representation of the reinforcer. Furthermore, in intervention session 4 he began to demonstrate behaviours such as attempting to climb onto the window sill once he saw the reinforcers that were available for the session. A change was then made to utilise Picture Communication Symbols (PCS) instead of photo material and the symbol size was made small relative to the size of the hotspot which was again bordered with a red line (Figure 6.4). Although some improvement was noted Lee climbed onto the window sill after the first ten minutes of the session. After a discussion with Lee's mother it was decided that he might benefit from more generic graphic symbols which would represent toys, food and drink. Generic symbols were used so that the reinforcers could be changed according to Lee's preference on the day e.g., the symbol for *PLAY* could be used to represent any toy which Lee wanted to play with.

Figure 6.4 VOCA display for Lee after procedural modifications

6.5.8.5 Follow-up

For each participant, three follow-up sessions were provided four weeks after the last intervention session in order to assess for maintenance of requesting skills. Participants had no access to the VOCA during the intervening period. Procedures were identical to those in the baseline phase and reinforcers were available as described in the general procedures.

6.5.9 Procedural fidelity

To assess reliability of the implementation of research procedures, an independent observer collected data for some baseline, intervention and post-intervention sessions using a data recording sheet designed for the study (Appendix 6; Schlosser, 2003a). This was scheduled to take place once in every three sessions. Procedural fidelity was collected across all study phases (Schlosser, 2003a). Procedural fidelity was recorded for 38% of all sessions. Scoring of the checklist was completed by an independent observer who was a qualified speech and language therapist. Training on how to score the checklist was provided by the lead researcher prior to the study similar to that provided in Study 1 (Section 3.2.9).

6.5.10 Inter-observer agreement

For each session, live data on the frequency of independent requests and the number of prompted trials was collected by both clinicians who were involved in implementing the study. The percentages of agreement between the two researchers were then calculated using the formula: agreements/ (agreements + disagreements) x 100 (Ayres and Ledford, 2014).

6.5.11 Social validity

Social validity was assessed using a questionnaire which was given to parents to complete in the last session of the post-intervention phase (Appendix 7). The first part of the questionnaire consisted of 10 questions in which parents were asked to rate statements on a Likert scale of 1-5. Part 2 consisted of three open-ended

questions. Transcripts for the open ended questions and the coding of this data are found in Appendix 15.

6.5.12 Data analysis

The data were graphed for each participant and a visual analysis of the data carried out to identify if there was a functional relationship between the introduction of the treatment and requesting behaviour (Figure 6.4). The analysis included a visual examination of the data for trend, level and stability for each participant (Lane and Gast, 2014). Supplementary calculations are available in Appendix 5. The data from the 11 questions which were rated on a Likert Scale in the social validity questionnaire were analysed using descriptive statistics. The open ended questions were transcribed and analysed using thematic analysis (Braun and Clarke, 2006).

6.6 SCED study results

The results of the MPD are presented first. These are then followed by the results of the social validity assessment.

6.6.1 Procedural fidelity results

Procedural fidelity results for each phase of the study are displayed in Table 6.4. Ninety-nine percent (range, 96%-100%) procedural fidelity was calculated for Noah. Ninety-five percent (range, 90%-100%) procedural fidelity was calculated for James, while procedural fidelity was calculated at 97% (range, 95%-100%) for Lee. For Max, procedural fidelity was calculated as 98% (range, 93%-100%). Calculations of procedural fidelity were made by dividing the number of observed behaviours by the number of planned behaviours multiplied by 100 (Gast, 2014b).

Table 6.4 Study 4: Procedural fidelity results

	Baseline probe	***Intervention***	***Post-intervention***
Noah	100%	97.7%	100%
James	100%	91%	99%
Lee	95%	97.6%	100%
Max	100%	95%	100%

6.6.2 Inter-observer agreement

The mean percentage of observer agreement across all participants was 99.4%, for all sessions with Noah 99.6% (range, 98%-100%), for all sessions with James 99.1% (range, 97%-100%), for all sessions with Lee 99.1% (range, 96%-100%), and for all sessions with Max was 99.8% (range, 98%-100%).

6.6.3 Participant results

6.6.3.1 Baseline

The results for all participants are displayed in Figure 6.5. All participants exhibited a stable zero performance in the baseline probe condition as they did not request independently using the VOCA on any occasion. Noah touched the VOCA display frequently in the first baseline session although this appeared to be random. James looked at the VOCA display and touched the graphic symbol which represented yoghurt on one occasion. Lee showed no particular interest in the VOCA and turned the screen face down on one occasion. Max touched the VOCA screen randomly in the first baseline probe session but showed no further interest in the VOCA in latter baseline sessions.

6.6.3.2 Intervention summary

Once the intervention phase was introduced, an abrupt change in the level of independent requesting was evident for Lee and Max. Both Noah and James demonstrated a delayed increase in independent requesting behaviour with change being evident from the second intervention session.

Table 6.5 displays a summary of the sessions and percentage of errors to criterion in the intervention phase, and the mean percentage of correct requesting in each phase for the individual participants and for the overall group. Criterion was achieved for all four participants in between 5 and 8 sessions. Noah and Lee required 8 and 7 sessions respectively to achieve criterion. James needed 6 sessions to achieve criterion while Max required the least amount of sessions achieving criterion in 5 sessions.

Table 6.5 Study 4: Effectiveness data for learning to use the VOCA to request with grid display

Participant	***Baseline probe %***	***Intervention %***	***Post-intervention %***	***Errors to criterion %***	***Sessions to criterion***
Noah	0	49.4	81.7	50.6	8
James	0	50.1	85.2	49.9	6
Lee	0	42.6	88.7	57.4	7
Max	0	68.2	89	31.8	5
Overall (mean)	0	52.7	86.2	47.2	6.5

Noah and Lee made the greatest percentage of errors to achieve criterion, and also took the longest to achieve criterion. All four participants maintained independent requesting behaviour in the post-intervention phase.

When PND scores were calculated, the intervention was highly effective for Lee and Max as PND metrics were 100% for both children. The PND scores indicated that the intervention was less effective for Noah and James who both achieved scores indicating the intervention was fairly effective. For Noah, the score was 87.5%, for James, the score was 83.3%.

Each participant's individual responses are described in greater detail below. For each participant, a description of the results which specifically provide an interpretation of the data graphed in Figure 6.5 and tabulated in Table 6.5 are

referred to. Each participant's performance in the post-intervention and follow-up phases is described. A description of the sensory processing interventions which were provided is also included for each participant in an attempt to describe the provision of a responsive intervention for each child.

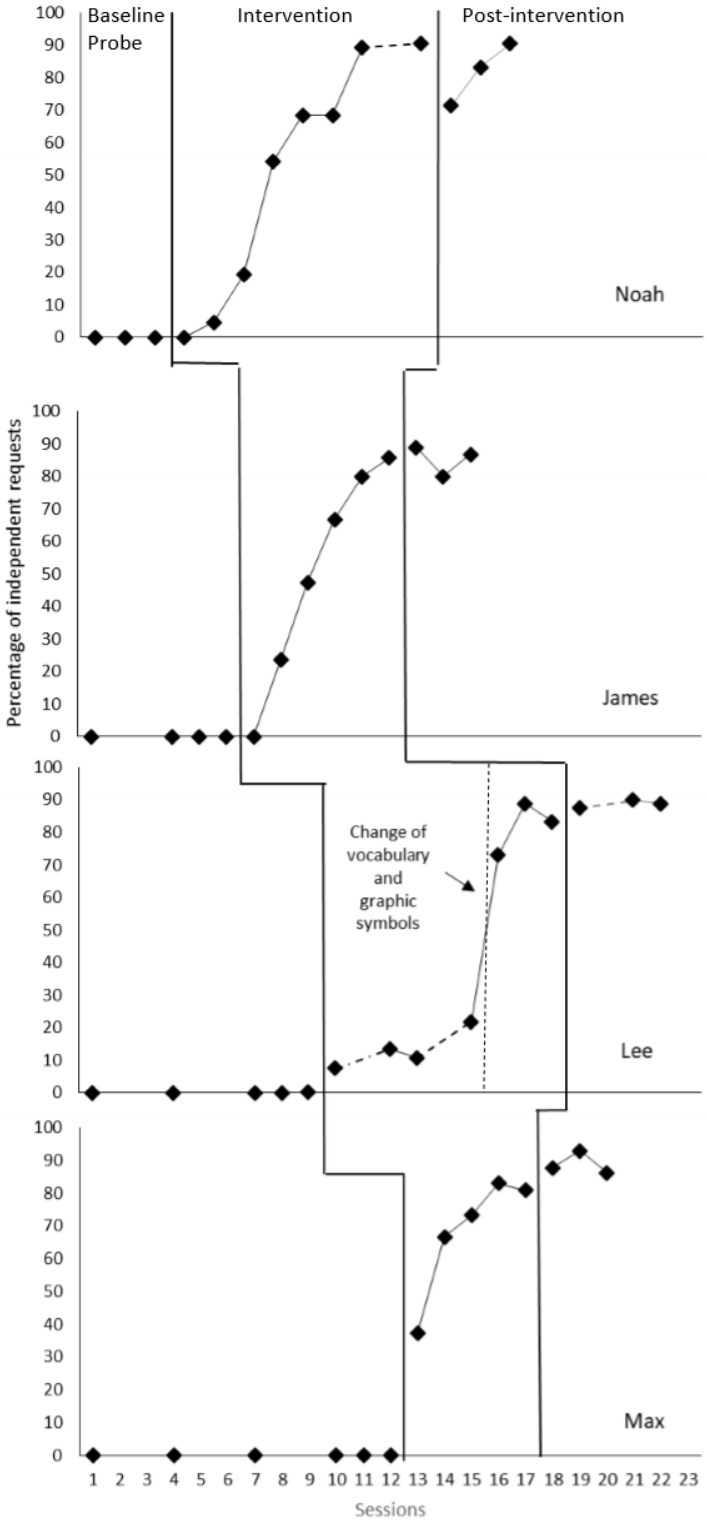

Figure 6.5 Percentage of correct requests with VSD and grid display conditions across phase for each participant.

Note. The dashed lines indicate a missed session between sessions.

6.6.3.3 Noah

Noah required eight sessions to achieve criterion during the intervention phase. In his first session, some evidence of discrimination between the visual-graphic symbols on the display was immediately evident as Noah touched the symbol of the desired object but as he failed to pick up the VOCA and reach with it towards the communication partner this was considered to be an incorrect response. Noah also failed to orient his body or look towards communication partners when requesting. Full physical prompting was faded by the end of the first session although there appeared to be some difficulty with the weight of the VOCA which seemed heavy for Noah to lift.

In session 2, Noah required full physical prompting at the start but he was able to request independently by the end of the session. In sessions 3 and 4, Noah began to slide the VOCA across the table or floor (depending on where he chose to sit) and this appeared to be due to the weight of the device. Incorrect responses were due to this, and also due to inadvertently touching the VOCA display before picking up the VOCA. From session 5 onwards, Noah began to pick up the VOCA and carry out the reaching sequence more easily. In his final session, Noah began to self-correct if he pointed to the display before picking up the VOCA.

In the post-intervention sessions, Noah's level of independent requesting dropped below criterion in the first session. He again appeared to have difficulty picking up the VOCA although he began to pick up the device and request independently as the post intervention phase progressed.

Noah, who presented with a hypo-reactive sensory processing pattern, received 15 minutes of sensory motor interventions before each session in the AAC clinic. The focus of these sessions was to increase his arousal levels. Environmental modifications were also provided during the AAC sessions and included, for example, allowing Noah to sit on the floor during play activities if he wished to do so. In this position, however, Noah required physical support from the waist in

order to be able to lift up the VOCA this was provided by the physical prompter. The physical support was no longer needed after session 5.

6.6.3.4 James

James achieved criterion on the sixth intervention session. During his first two sessions, James was constantly requesting the clinicians to provide him with activities which would provide him with deep pressure. Deep pressure is defined as firm touch which can be provided in a number of ways including massage, vibration, and having the child lay under a heavy object (Manolov et al., 2014). James' need for deep pressure was constant and impacted on his ability to complete any functional activity including learning to request with the VOCA. By the end of the first session, however, he was able to manage some parts of the motor sequence required to request with the VOCA. At times, therefore, he picked up the VOCA to reach with it, and at other times he touched the correct graphic symbol for what he wanted. By session 5, James appeared to have grasped how to request desired items with the VOCA as the majority of incorrect responses were due to touching the display before picking up the VOCA.

In the post-intervention phase, James maintained independent requesting above criterion level. Incorrect responses in this phase were mainly due to occasionally forgetting to pick up the device or requesting through pointing.

Challenging behaviours such as pulling the clinician's hair, biting, and pinching were evident in the majority of sessions. Session 4 was terminated after 15 minutes as James was distressed because he wanted more yoghurt and this was not available as he had already eaten it. Strategies such as encouraging James to press his hands together and supporting him to wheelbarrow walk in which James was encouraged to walk on his hands were used to provide sensory motor input in the AAC clinic room. James, who presented with a hypo-reactive sensory processing pattern, also received 15 minutes of sensory processing interventions in the sensory motor room prior to each session in the AAC clinic room.

6.6.3.5 Lee

Although Lee made some independent requests in session 1 of the intervention phase he appeared not to want to touch certain areas of the display. Initially it was thought to be the red borders delineating the hotspots but by session 4 it was clearer that the issue was the photos of the reinforcers. Lee's results for the first 4 sessions were variable and therefore a decision was taken to decide what changes might support Lee to request independently. It was decided to change the display in two ways: firstly to use a symbol instead of a photo, and secondly to use vocabulary which could be used to represent a variety of reinforcers e.g., *PLAY* could be used to request any toy. Once the display was modified to include symbols instead of photos, Lee quickly achieved criterion and there were no longer issues with touching the display.

In the post-intervention phase Lee's mean percentage of independent requesting was higher than in the intervention phase. He also self-corrected when he touched the screen without picking up the VOCA. In his final session, Lee pressed *WANT* followed by *PLAY* spontaneously.

Lee presented with a sensory processing pattern which fluctuated between hypo- and hyper-reactivity. Sensory processing interventions were provided to Lee before his AAC sessions. Environmental modifications were also utilized in the form of physical structure created by the arrangement of furniture. Furthermore, environmental modifications consisting of predictability which was built into the sessions and allowing Lee choice of a greater range of reinforcers was also used.

6.6.3.6 Max

Max required five sessions of intervention to achieve criterion in the intervention phase. On his sixth trial in the first intervention session, Max requested a puzzle piece independently. The prompting protocol had to be reinstated within the first intervention session as he did not spontaneously generalize to requesting other reinforcers. In sessions 2 and 3, incorrect responses were due to pressing a visual

which did not correspond with the desired reinforcer. In session 2, this appeared to be due to an automatic response as Max used his left hand to access the VOCA display and automatically touched a cell on the left side of the display. In these instances he self-corrected before the voice output was emitted. From session 2 onwards, Max began to take great interest in the VOCA's voice output and this was demonstrated by putting the VOCA to his ear to hear the voice. In session 5, it was noted that Max refused to touch the visual-graphic representing the puzzle reinforcer and instead touched the visual-graphic representing *BLOCKS*. Eventually the SLT realised that Max wanted a red puzzle which was not in the graphic-symbol representing *PUZZLE*. The blocks photo had red blocks and it was thought that he was using this visual-graphic to request the specific puzzle he wanted by colour.

In the post-intervention Max maintained the requesting that he had achieved in the intervention phase. In each session of this phase, he put the device to his ear to hear each recorded hotspot. In sessions 2 and 3 of the post-intervention phase Max stopped looking at the device when requesting reinforcers and began to access the display automatically. Occasionally his requests were so fast that he pressed an adjacent cell although he self-corrected in these instances.

Max presented with a hyper-reactive sensory processing pattern in conjunction with a postural sensory disorder. His sensory processing interventions were provided in the AAC clinic room together with the AAC interventions. This included the use of a ball chair for sitting purposes, allowing Max to stand or take a small movement break when desired, and the use of furniture to create physical boundaries in the room. All activities were reinforcers which had a clear beginning and end and an area of the room was designated for returning reinforcers to once Max had finished playing with them.

6.6.4 Social validity results

The mothers of all four participants completed the social validity questionnaire. In addition, Noah's father also completed the questionnaire. Parents completed the questionnaire independently after the last post-intervention session. Sections one and two of the questionnaire were analysed separately. Section one assessed parental opinion of the strategies used during the study using a 5-component Likert scale. Responses were analysed using descriptive statistics and are displayed in Table 6.6. Section two consisted of three open ended questions which were designed to gain information on parental opinion of the impact of the intervention provided on their children's communication skills. The transcripts for these responses and the corresponding coding in the thematic analysis process can be found in Appendix 15. The resulting thematic network is presented in Figure 6.6.

6.6.4.1 Quantitative results

On the test items which utilised a Likert scale, a score of '5' indicated the most positive rating, a score of '1' was the least positive with the exception of questions 4 and 9 which were reverse coded. All caregivers reported a very clear understanding of the intervention strategies used and stated that they found these to be very acceptable. Furthermore, they stated that they were very willing to use these at home. All caregivers were confident that the use of such intervention strategies would be effective and that it was very likely that they would make a permanent improvement to the child's communication. Parents were neutral on the disadvantages of the interventions utilised in the study with responses ranging from not very likely to could be likely. Similarly, parents were neutral on the time needed to implement interventions in the home situation with some parents stating that no time would be needed while others feeling that much time would be needed. Caregivers' responses indicated that they felt that the use of such intervention was likely to cause some disruption to home life although there was one parent who did not feel that that would be the case. The responses also indicated that parental perception was that there could be some side effects

associated with the intervention, although the majority of caregivers were either neutral or stated that they did not feel there would be any side effects. In general, parents reported that the intervention had many positive effects on their children's requesting skills. Specifically, the intervention was reported to have some effects on their children's social skills and speech.

Table 6.6 Study 4: Social validity questionnaire results

Question	***Mean response***	***Range of responses***
1. How clear is your understanding of the interventions strategies implemented with your child	5-Very clear	Not applicable
2. How acceptable do you find the intervention strategies to be regarding your concerns about your child?	5- Very acceptable	Not applicable
3. How willing are you to use these intervention strategies at your home?	5-Very willing	Not applicable
4. To what extent do you think there might be disadvantages in following these intervention strategies?	2.8-Neutral	2-Not very likely 4-Could be likely
5. How likely are these intervention strategies to make permanent improvements in your child's communication?	5-Very likely	Not applicable
6. How much time would be needed each day for you to implement these strategies?	3.4-Neutral	1-Little time will be needed 3-Neutral 4. Some time will be needed 5-Much time will be needed
7. How confident are you that these strategies will be effective?	5-very confident	Not applicable
8. How disruptive will it be to your home life to implement these intervention strategies?	1.6-A bit disruptive	1-Not at all disruptive 2-A bit disruptive 3-Neutral
9. To what extent are undesirable side-effects likely to result from these intervention strategies?	2-A few side effects are likely	1-No side effects are likely 2-A few side effects are likely 3-Neutral
10. Have you noticed any positive effects on your child's communication in any of the following areas?		
d) Improvements in requesting skills	4.8-Many effects	5-Many effects 4-Some effects
e) Better social interaction with others	3.8-Some effects	3-Somewhat 4-Some effects
f) Emerging speech	2.4-Some effects	2-A few effects 3-Somewhat

6.6.4.2 Qualitative results

The qualitative data from the open ended questions in section 2 of the social validity were analysed and three themes were identified:

1. Benefits of teaching the child to request with the VOCA.
2. Implementing AAC interventions
3. Feelings towards VOCAs

Each theme was made up of sub-themes which were derived from the data and was represented visually by a thematic network entitled: Parental perceptions of the AAC intervention (Figure 6.6). Each theme is discussed in turn below. Participants' quotes are used to support the results.

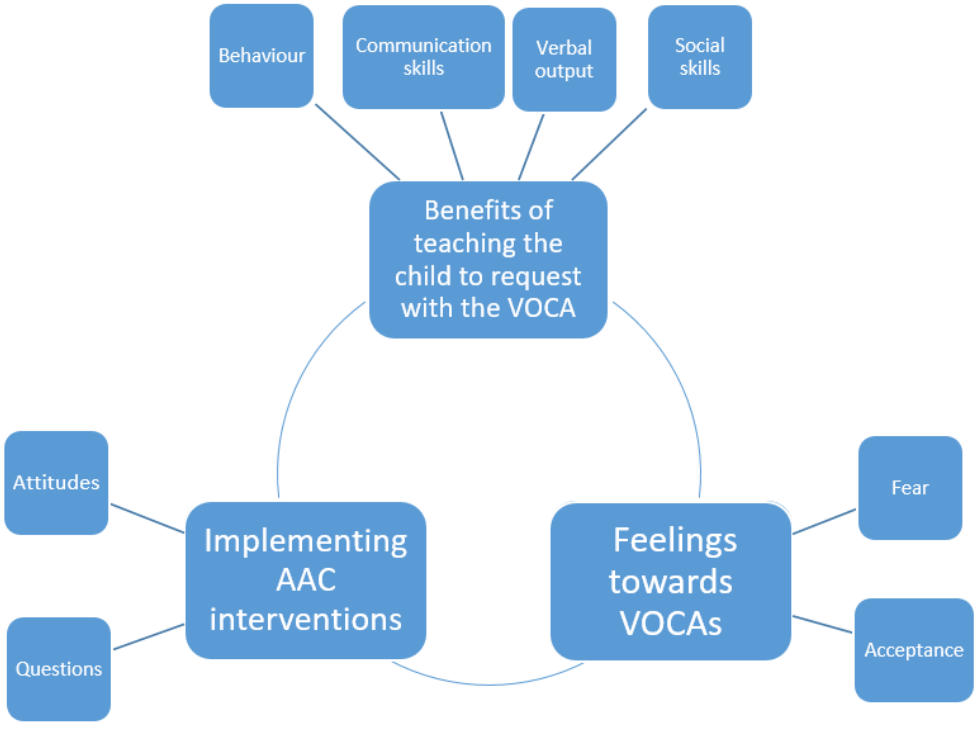

Figure 6.6 Study 4: Parent social validity thematic network: Parental perceptions of the AAC intervention

Theme 1: Benefits of teaching the child to request with the VOCA

This theme was composed of four sub-themes. The majority of parents perceived that the intervention provided had positive effects on a number of areas of their children's development.

Overwhelmingly all parents reported an improvement in their children's communication skills. This was noted across a range of areas including requesting which was taught in the study, but also included eye contact, pointing, attention, comprehension, and the ability to make choices.

> *Lee's mother: Lee learnt to ask for something by clicking on the picture on the tablet. He learnt to use the tablet without being prompted to do it. He realised that if he used the tablet he could get what he wants.*
> *James' mother: He still made some play choices even if it was sensory.*
> *Noah's father: He looks at me when he asked for what he wants.*
> *Max's mother: I see him understanding more, following instructions at home, school, with his dad.*

Furthermore, parents commented on positive increases in the frequency of communication:

> *Noah's mother: He is communicating more with us.*

For two children parents noted there was also an increase in vocal output:

> *Noah's mother: I hear him say different sounds like 'e' and they have different pitches.*
> *James' mother: He said 'no' after I said it*

Parents stated that there was an increase in social skills which included the ability to interact with others:

James' mother: I noticed he is interacting with his cousin.
Max's mother: He is interacting more with other children, allowing his sister in a little.

Furthermore, parents referred to improved play skills:

Noah's mother: …he is playing with proper toys like a trainset and cars and he is exploring them.

Some respondents made references to improved behaviour as a positive outcome of the intervention provided:

Noah's mother: Not getting so many meltdowns.
James' mother: There was some decrease in frustration. He is waiting longer too. Looks at it but will wait. If I told him 'wait' before, he wanted it immediately.

Two of the parents referred to motor skills as an outcome of the intervention:
Noah's father: Now he's jumping the steps, trying to build the blocks, he has strength in his body

Lee's mother also referred to motor skills indicating that she had gained insight into what could be a key to helping her son to learn:

Lee's mother: I think it works, he needs movement to concentrate.

Theme 2: Implementing AAC Interventions

The second theme entitled *Implementing AAC Interventions* revealed insights into what parents thought should be considered when implementing AAC interventions beyond those provided in the study. This included two subthemes: questions

about how the interventions should be implemented and the attitudes the parents felt are required to achieve positive results.

The analysis indicated that the respondents understood that they themselves needed to take a role in providing the implementation of AAC interventions.

> *James' mother: I think I can help James to use a device at home…*

Participants reported that the AAC device could be used in multiple environments including home and school and this was implicitly linked to an understanding that by doing this there could be an increased rate of progress:

> *Lee's mother: I would like to do this at home, school. There would be a continuation… I think if we did this at home there would be more progress.*

Furthermore, parents identified that they would need to make changes to the home environment to facilitate communication opportunities:

> *Noah's mother: …I will have to move things out of reach.*

The respondents noted that persistence would be needed in providing interventions as they identified that the clinicians themselves were persistent during the study sessions:

> *Max's mother: you were persistent with him so if he didn't do what you wanted he didn't get it*.

This sub-theme also included parental attitude to their children's ability to learn how to use the AAC device. This was included under implementing AAC interventions because it reflected the belief that the children could learn the skills

to use an AAC device to communicate but that parents were acknowledging that they also had a role to play in the provision of AAC interventions.

> *James' mother: I think I can help James learn to use a device because once he is shown something and if it's within his potential and he feels it's advantageous he can learn it*

Theme 3: *Feelings towards VOCAs*

The third and final theme entitled *Feelings towards VOCAs* includes both negative and positive emotions which parents feel towards using AAC systems with their children and is subdivided into two sub-themes: Fear, and Acceptance.

In general parents had fears that the use of an AAC system would prevent their children from talking:

> *Noah's mother: Maybe he might get lazy to speak. Instead of saying the word he might press [the cell on the VOCA].*
> *James' mother: He might become dependent on the device and not talk.*

Max's mother also had a fear that apart from impacting on Max's speech development, the AAC device would be used as a plaything and not for communicative purposes.

> *Max's mother: I'm afraid it will make him lazy to talk. I hope he learns to use it to 'talk' not to play.*

While many of the parents appeared to have some fears that the use of an AAC might prevent their children from using speech to communicate, they was also acceptance that an AAC system was necessary in order to support communication skills. They were particularly focused on the idea that the use of an AAC system

could prevent behavioural challenges and stop their children from being frustrated:

> *Noah's mother: …but its better [that] he has a system of communication. If he can't communicate he might have a meltdown.*
> *James' mother: but I know there will be less frustration…… I'm hoping he will learn how to use a high tech AAC device to decrease his frustration.*

Max's mother also stated that the decrease in her son's frustration would also stop the adults in Max's life from being frustrated. Furthermore, she viewed the use of an AAC device as a system which would save her time as she would understand him faster and he would not need to resort to challenging behaviour to communicate his needs. She therefore indicates how keen she is to start implementing the system herself.

> *Max's mother: I want to try this, if it will help him to be less frustrated, yes, for him and for us, for everyone. In the long term it will save time because I will know faster what he wants. He will be calmer.*

6.7 Qualitative study methods and analysis

The second strand of the mixed methods study was a focus group, the aim of which was to explore clinicians' perceptions and observations of how AAC specialist clinicians interact with children with ASC and co-existing sensory processing difficulties during the provision of AAC interventions to this group of children. The focus group data led to the generation of several themes which were then represented visually as thematic networks (Braun and Clarke, 2006).

6.7.1 Procedure

The qualitative strand was divided into two phases (see Figure 6.7). In the first phase, participants, also referred to as focus group AAC clinicians, individually observed the intervention sessions provided by the AAC specialist clinicians in the

quantitative study described in Section 6.5.8.3. Due to lack of access to a clinic room with an observation room, observations were live in the intervention room and parents were informed of this in the information sheet. The chair labelled Observer 2 in Figure 6.2 provides a plan of where the observer sat during the intervention sessions.

A diary guide was provided to support the focus group AAC clinicians to observe the AAC specialist clinicians' communication with the participants. The diary guide (Appendix 9) listed a range of communicative behaviours which the AAC specialist clinician might utilise when communicating with children during intervention sessions (Knapp et al., 2013). These included the following:

- Gesture and touch
- Touch
- Face
- Eye behaviour
- Vocal cues
- Verbal language

The observations recorded by the focus group AAC clinicians was intended for use as a prop which they could refer to in the second phase of the study when the focus group took place. As the focus group AAC clinicians worked within the same clinical team they were advised not to discuss their observations with each other at any time during the observation phase.

In the second phase of this strand of the study, the focus group AAC clinicians who made observations took part in a focus group. The focus group AAC clinicians were asked to bring their diaries with them as props to support focus group discussion (Hennink, 2014). The moderator of the focus group was a university lecturer with an occupational therapy background. The author of the present thesis and lead researcher assumed the role of assistant moderator who was

present to take field notes during the discussion. The moderator utilised the questions which can be found in Appendix 10 to guide the focus group discussion.

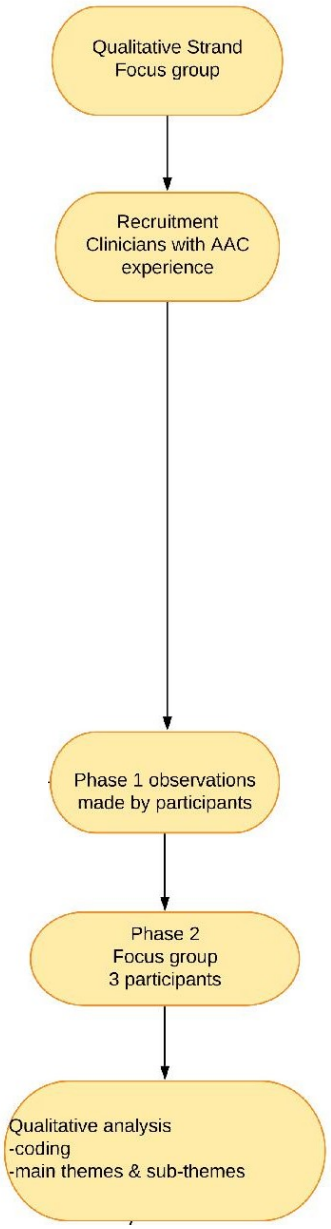

Figure 6.7 Study 4 phases: Qualitative strand within mixed methods study

6.7.2 The researcher

The researcher was a speech and language therapist with 20 years of experience of delivering AAC interventions to children with ASC. The researcher was involved in providing the clinical interventions described in the SCED strand of this mixed

methods study (Section 6.5). During the focus group, the researcher served as the assistant moderator. It is important to acknowledge the potential influence of the researcher in this qualitative study as her work experiences may have influenced data collection, data analysis, and the interpretation of findings (Richards and Emslie, 2000). In view of this, it was necessary for the researcher to attempt to contain her theoretical and practical knowledge to reduce the potential effects of that knowledge on the descriptions and explanations of the topic being investigated (Schostak, 2005). Furthermore, the focus group AAC clinicians were colleagues working on the same team as the researcher. Every effort was made not to discuss the profiles or progress of the children who took part in the SCED so that the focus group AAC clinicians' observations were independent of researcher influence. The interviewer for the focus group was a university lecturer with a qualification in occupational therapy.

6.7.3 Preparing for the focus group

Phase 1 comprised of focus group AAC clinicians who observed live intervention sessions by recording their observations in a diary during the interventions as preparation for the focus group. All focus group AAC clinicians received a training session to ensure they understood the purpose of the study, the role of the diary keeping in the study and the way the diary should be maintained (Appendix 9). Each focus group AAC clinician then observed two intervention sessions with each of the four children. The focus group AAC clinicians were asked to bring the diary to the focus group session which took place after the intervention phase in the quantitative study was completed.

To address the objectives of this study, an interview guide (Appendix 10) was developed by the researcher for the questions to be asked during the focus group. The questions asked sought to answer the research question for the study:

What are the focus group AAC clinicians' perspectives of how specialist AAC clinicians communicate during the provision of AAC interventions to children with a diagnosis of ASC and co-existing sensory processing difficulty?

The interview guide was designed to elicit discussion from the focus group AAC clinicians who were the participants. Prompts and probes as suggested by Liamputtong (2011) were used to support the focus group AAC clinicians to discuss and promote greater interaction between them. The following order of questions was considered when constructing the interview guide:

1. Opening questions (to be answered by all participants)
2. Introductory questions
3. Transition questions designed to move the participants to the key questions
4. Key questions
5. Final questions

Prior to the focus group, the interview guide was discussed in detail with the moderator in order to clarify the meaning of the questions.

6.7.4 Recruitment of participants

A purposeful sampling procedure was used to recruit the participants. In this study it was decided to recruit AAC clinicians from within the ACTU team. This was a naturally occurring sample of people who work together (purposive sampling). In this situation, all AAC clinicians had experience in the area of providing AAC interventions to children with a diagnosis of ASC and this was considered advantageous as they were able to relate their comments to their work lives (Kitzinger, 1995). Furthermore, their shared work experiences provided the researcher with greater insight into their thoughts and experiences on specific issues supporting them to talk more (Liamputtong, 2011).

Seven clinicians, who were team members of ACTU and not involved in the implementation of the quantitative study, were sent an email asking if they were

interested in participating in the study. In order to prevent coercion, the researcher did not discuss recruitment for the study with the team members in any other way. An information sheet and consent form was given to three AAC clinicians who showed interest in taking part in the study (Appendix 2). Kitzinger (1995) suggests that the ideal size of a focus group should be between four and eight. Only three participants consented to take part in the study. According to Kitzinger (1995) although a smaller group may lose some of the qualities of being a group, it is still possible to run a focus group with less than four participants.

All the focus group AAC clinicians who were participants worked full time in the area of AAC, had day-to-day involvement in conducting AAC assessments, and experience of implementing AAC interventions with children with ASC. Participant characteristics are described in Table 6.7.

Table 6.7 Study 4: Participant descriptions for the focus group

Participant	***Age***	***Sex***	***Professional background***	***Years of AAC intervention experience***
Andy	33yrs	M	Occupational Therapy	2 years
Meg	26yrs	F	Speech and Language Therapy	2 years
Jo	25yrs	F	Speech and Language Therapy	18 months

6.7.5 Data collection

The focus group data collection took place in a room at the University of Malta. This was considered to be a neutral venue. As suggested by Kitzinger (1995) the seating arrangement was a circular one which allowed the participants to face each other thus enabling equal access to each other and thereby facilitating greater interaction between them (Liamputtong, 2011). Furthermore, the seating arrangement supported the interactive dynamics of the group, an essential element of focus group discussion (Hennick, 2007). The semi-structured group discussions were supported by the moderator.

The focus group was conducted in the English language as all participants were comfortable in this language. As suggested by Krueger and Casey (2014) the pattern for the group discussion was as follows:

1. Welcome
2. Overview of the topic
3. An outline of the ground rules. This included a reminder that the discussion would be tape recorded.
4. Questions (Appendix 10).

The session lasted approximately one hour and was audio recorded using two Sony digital voice recorders (model ICD-PX312).

After the focus group AAC clinicians left the room, a debriefing session was held between the moderator and assistant moderator to review the major points that were made from multiple perspectives. The focus group discussion was then transcribed by the assistant moderator verbatim using a notational system described by Braun and Clarke (2013). The transcripts were returned to the focus group AAC clinicians to check for accuracy of transcription.

6.7.6 Data analysis

The six phase procedure for thematic analysis described in Section 5.2.7 by Braun and Clarke (2006) was utilised to analyse the data. The coding framework was devised based on the salient issues which arose from the text itself, thus the coding framework was based on recurrent issues in the text whilst being guided by the research questions. Data reduction in the form of a matrix was then utilised to further focus the analysis on a specific theme (Guest et al., 2012).

6.8 Qualitative study results.

6.8.1 Participants

The focus group participants were AAC clinicians; an OT and two SLTs employed by ACTU. All AAC clinicians were engaged in the assessment and implementation

of AAC on a full time basis. All participants had less than two years' experience in the area.

6.8.2 Thematic analyses

The focus group data was transcribed in Phase 1 and is available in Appendix 16. At the end of Phase 2 a total of 200 codes were identified and these were then grouped together into subthemes and themes (Appendix 17). Thematic networks were then constructed in Phase 4.

Three themes were identified which although separate also appeared to be intricately interconnected as demonstrated in Figure 6.8. This figure visually represents the three themes as interlocking because one theme appeared to influence another: thus a change in an element in one theme creates a change in the other themes. The theme: *Diversity impacts clinical outcomes in AAC interventions* is deliberately placed in the biggest cog because this is the starting point of interventions: the individual child. When providing AAC interventions the focus group AAC clinicians referred to how each child was approached on an individual level, thus acknowledging the diversity within this group of children and the need to start with a thorough understanding of each child's individual characteristics. The second cog refers to the child-clinician bond which is the subject of the second theme: *The child-clinician bond is fundamental to the implementation of AAC interventions.* Clinicians seek to establish a bond within each child encounter because this is considered essential to successful interventions. To accomplish successful bonding with children with ASC, clinicians utilise clinical skills as human tools. This refers to the third theme: *The clinician as a human tool enables the implementation of AAC interventions.* This theme fits with the previous two themes because clinical skills are tailored according to the individual child and are utilised in forming the bond and also within the intervention process. All elements within the figure are therefore related to each other. The interconnections between the three themes are represented visually in Figure 6.8.

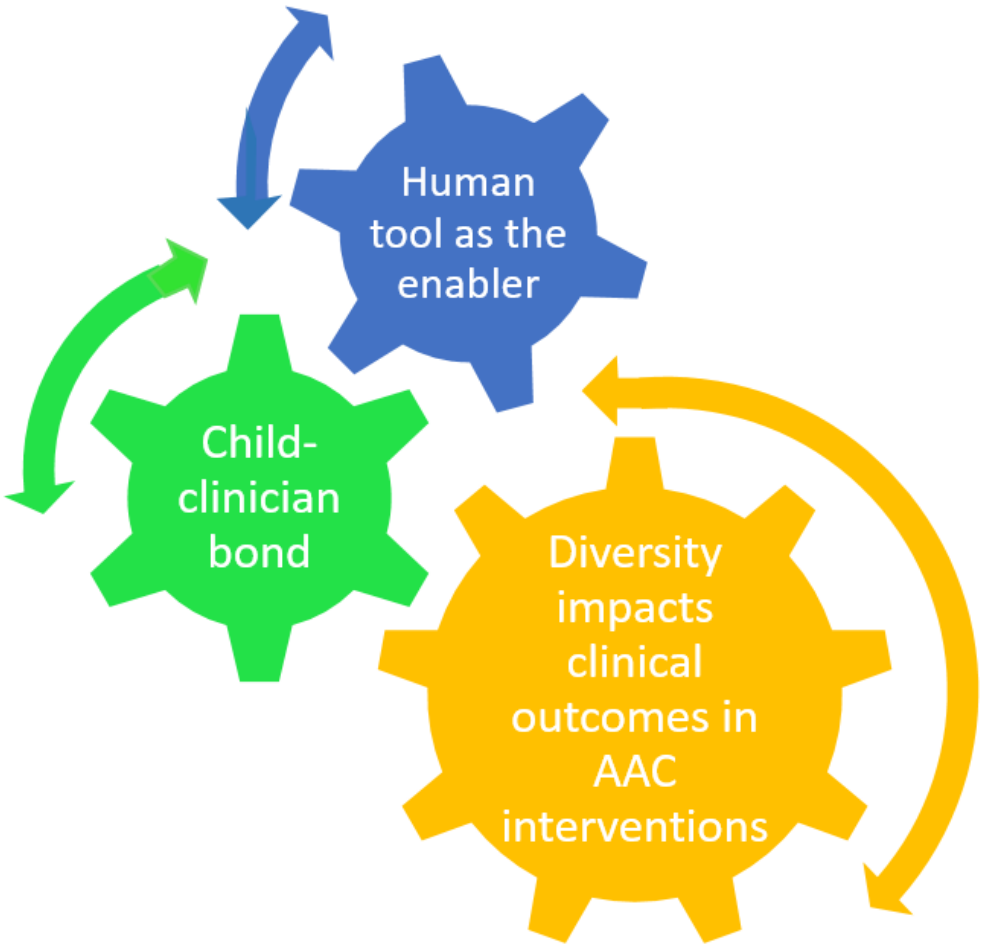

Figure 6.8 Study 4: Visual representation of the interconnection between the themes

The three themes identified from the data represented the focus group AAC clinicians' thoughts and ideas expressed during the focus group (Figures 6.9-6.11). Each theme will be presented in turn with selected quotes to illustrate the themes (Bluff, 1997).

Theme 1: Diversity impacts clinical outcomes in AAC interventions

This thematic network deals with the ways clinicians could improve clinical outcomes when providing AAC interventions to children who have a diagnosis of ASC and are also minimally verbal. It refers to how children with ASC differ from each other in many ways and that this is pivotal in the consideration of providing

AAC interventions to this group of children (Figure 6.9). Furthermore, this diversity was perceived as being tied to how children progressed within AAC focused interventions. A very strong sub-theme was that of sensory processing differences within this group of children and the need for these to be addressed when considering AAC interventions. The focus group AAC clinicians' perceptions were that such differences can affect the child's progress in AAC interventions and they therefore stated that sensory processing should be assessed for in the initial stages of AAC assessment alongside existing communication skills. The focus group AAC clinicians suggested that intervention to address sensory processing difficulties could be planned for as an adjunct to AAC interventions. Furthermore, they identified that sensory processing interventions for this client group need to be tailored for each child according to the outcomes of the assessment. They noted that for some children, sensory processing difficulties could be addressed in the clinic room in which AAC interventions are provided through the use of environmental modifications. For others they referred to the need to provide sensory motor interventions before the AAC intervention session.

Figure 6.9 Study 4: Theme 1. Diversity impacts outcomes in AAC interventions for children with ASC

The first sub-theme specifically referred to the **differences which exist** within this group of children. The focus group AAC clinicians discussed how the children had varying levels of comprehension, how the children were interested in different reinforcers, and how their progress differed from each other. In the quote below Andy described J's level of inconsistency compared to other children's progress in the study:

> *Andy: …the others they were more a bit more, (.) there was a kind of pattern, so even communication, even if it at this point we reduce the*

physical prompting then it was consistent where we're shifting away from physical prompting to verbal prompting, there was like consistency, OK, we're at this level, now what's next? But when it comes to J I think I saw ups and downs going back to square one multiple times resorting back to physical prompting...

This sub-theme also referred to how the children's sensory processing difficulties impacted on learning to use the VOCA. Andy summarised his impressions of how the sensory processing difficulties impacted on one of the children in this quote and how this acted as a barrier in terms of achieving AAC goals:

Andy: The only thing with J is that identified, that [I said] before, if they didn't tackle his sensory issues, they, it was a big wall getting to the goal

The second sub-theme focused on how **sensory processing difficulties can be addressed** in order to meet AAC goals. Jo described how the sensory processing needs of one of the children were addressed during the AAC intervention during typical play activities:

Jo: The sensory needs, I think the therapists were addressing them quite well, for instance, on one occasion, the therapists wanted to play with the ball but emmm one of the therapists used, actually used the ball to apply pressure

Andy noted that for some children, sensory processing interventions were provided before the AAC intervention, while for others it was provided during the AAC intervention in the form of environmental modifications and that this was individualised according to the child's needs:

Andy: Even the structure of the session varied from one child to another, the children needed sensory motor input before, others didn't. Some

children needed sensory motor input, some children needed environmental modification for them to, [get] what they needed, so therapists were very attentive, I mean the sessions were planned individually according to the child…

Theme 2: The child-clinician bond is fundamental to the implementation of AAC interventions

This theme is made up of three sub-themes which focus on the child-clinician bond during the AAC intervention process (Figure 6.10) and emphasises the importance of the child-clinician relationship as a foundation for successful AAC interventions. Furthermore, establishing a child-clinician bond is seen as a way to learn about the child in order to enhance the outcomes of AAC interventions. This theme acknowledges that the clinician may not always recognise that the child with ASC is forming a bond as this may not be evidenced in the usual ways. Furthermore, given the heterogeneity of this group it may be more difficult to establish this bond with some children than with others. The theme suggests that the clinician should take an active role in building the child-clinician bond. This involves using of his/her own communication skills, using clinical strategies, the identification of other materials such as reinforcers, and the environment itself. Moreover, the participants referred to the need to ensure that the emotional aspects of the child-clinician bond are established through building trust and ensuring the child's comfort. This theme also identified some barriers that can affect building a bond with a child with ASC.

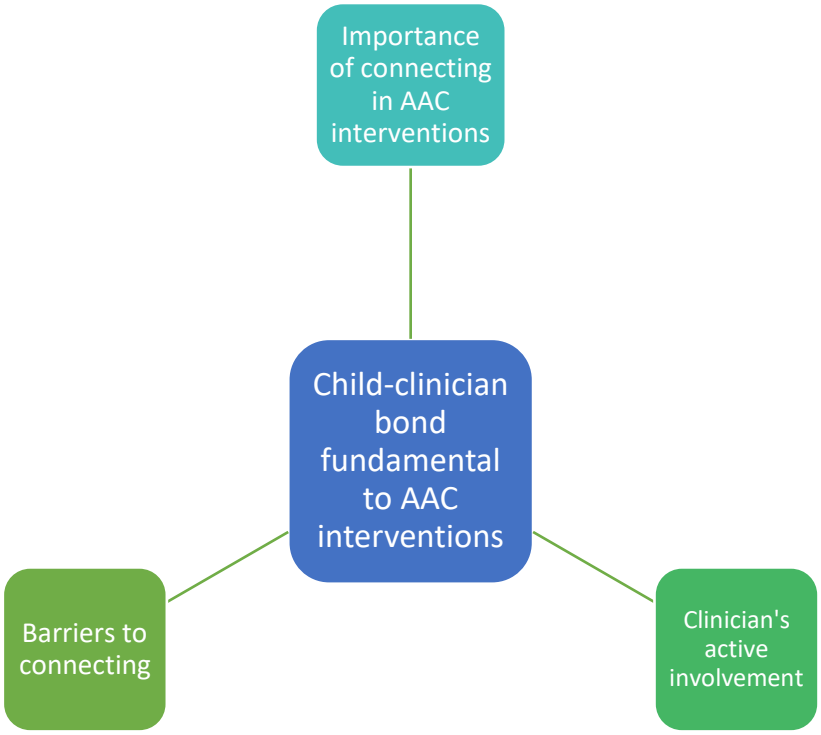

Figure 6.10 Study 4: Theme 2. Child-clinician bond is fundamental to AAC interventions

The first sub-theme focuses on the **importance of being able to bond with the child during AAC interventions**. The focus group AAC clinicians perceived that bonding with the child supported the implementation of interventions, supporting the child to do activities. In the following quote, Andy described how in his experience it can take some time to establish a bond and it was only after it was established that he felt able to begin implementing AAC interventions:

> *Andy: I can think of a particular child where it took us almost 8-9 months of regular intervention with the child to actually finally get some eye contact and actually get into his circle and you can feel that you're there, that's he's there with you and you can start doing something, a very good 8-9 months I think*

Meg provided further insight into the reasons for ensuring a bond is formed with the child when she stated that in taking time to get to know the child, to form the bond, the AAC specialist clinicians were learning how best to provide interventions:

> *Meg: And I felt the therapists were taking time to get to know the children, and looking and seeing, observing what they were doing, and by observing them and seeing what they were doing it would give them insight into how they can adapt the sessions for next time*

The second sub-theme focuses on the idea that the **clinician needs to be actively involved** for bonds to be formed with the child with ASC. The participants noted that sometimes the bond was not so obvious but that children with ASC may show in other ways that they have begun to form a bond with the clinician:

> *Meg: …sometimes children with autism lack eye contact and facial expressions but sometimes they show you in other ways relating (.) they take your hand, direct you to what they want. In a way you can still emmmm read what they want to tell you and you can feel a connection*

The focus group AAC clinicians felt that to a certain extent the onus of forming the bond with the child was on the clinician thus the use of clinician's communication skills plays an important role in forming this bond:

> *Meg: I think it's very important, the way you approach the child, not making him feel intruded on and also the tone of voice plays a very important role I feel*

Andy took the use of the clinician's skills in creating a bond with the child a step further. He referred to the 'use of self', a concept central to the occupational therapy profession as one way to support the formation of the bond:

> *Andy: Emmmm, one big thing that I noticed is the use of self when carrying out the session with the child, you could see, you could feel, even more, you can feel this even more when you're observing than when you're doing the session, ummmmmm, the way you as a person change your connection with the child, the way you present activities, the way you use your voice, the way you change without even thinking about it, your position, your voice, your energy in the session, when you see it that way it's unbelievable, we change as therapists*

An atmosphere of trust was perceived as integral to the formation of the bond between clinician and child:

> *Meg: but sometimes it requires more work from your end to kind of set the boundaries of the relationship between you and make the child feel comfortable so he can trust you, and I think the element of trust and comfort plays a big role in the relationship between you and the child*

The focus group AAC clinicians also described clinical strategies which they perceived as supporting the formation of the child-clinician bond. This included following the child's lead, looking at what the child is interested in, and offering choices:

> *Meg: I remember emmm one instance they had a child who was wanting something different and the therapist looked in the same direction to kind of connect with the child and experience the same thing the child was looking at in that instance.*

Knowledge of clinical strategies was important as forming a bond with a child with ASC was perceived to be different for each child. Andy described his experience of establishing a bond with children with ASC below:

> *Andy: I've experienced different scenarios when it comes to children with ASD, I've experienced children where you can quickly establish yourself with the child, in his little circle, where you go in very quickly, some children do let you in very quickly*

The third subtheme referred to **barriers in forming a connection** between the clinician and child with ASC. These were identified and included the clinician herself who may be too demanding or too rigid in her interactions with the child.

> *Andy: Cos sometimes when children feel you put too many demands on them they see you as as a (.) like a test or at school.*

Strong reinforcers which may take the child away from clinician oriented interactions were also considered to be detrimental to the process of forming a child-clinician bond.

> *Andy: …his parents might tell you he's very technologically inclined, so you say OK, using technology to get into his circle but then you use technology and it becomes his only thing and he blocks you out because of the computer.*

Finally, the inherent social-communication difficulties associated with a diagnosis of ASC could also be considered to be a barrier in forming a bond with a child with ASC as described by Meg:

> *Meg: …sometimes I feel, you have a child [with ASC], you try everything and nothing works, and you say what am I doing wrong?*

Theme 3: The clinician as a human tool enables implementation of AAC interventions

The focus of the third theme was how the clinician functions as a human tool in the provision of AAC interventions for children with a diagnosis of ASC (Figure 6.11). This brings the spotlight onto how the clinician is engaged in implementing interventions, as an adjunct to the actual AAC tool itself, the AAC device. This is done in many ways and includes how the clinician uses her communication skills during the implementation of interventions. The clinician's use of communication is, however, embedded in a multitude of other skills which the clinician brings to the table when providing AAC interventions and all of these skills influence each other. Skills identified by the participants included the need for the clinician to be persistent, and the ability to make interactions with children fun and playful. Furthermore, the participants identified that the clinician was knowledgeable about a range of strategies which she needs to be able to choose between when providing interventions. The clinician chose these according to the individual child thus providing child led interventions which are highly individualised yet still providing the support to achieve the overall communicative goal. The perceptions of the focus group AAC clinicians was that the session structure, the activities chosen and the environment itself were pre-planned yet the choice of strategies and the AAC specialist clinician's communication was influenced by the child's sensory processing patterns, resulting in personalised interventions designed to meet the child's individual needs. This included the provision of sensory processing interventions in conjunction with the AAC interventions. Moreover, when needed, the AAC specialist clinician was flexible and used her clinical experience to make adaptations to plans thus ensuring that the activities are presented smoothly but still with the communicative goal in mind. The thematic analysis revealed three sub-themes in this theme: communication, clinician's attributes, and clinical skills and knowledge which will be discussed in turn below (Figure 6.11).

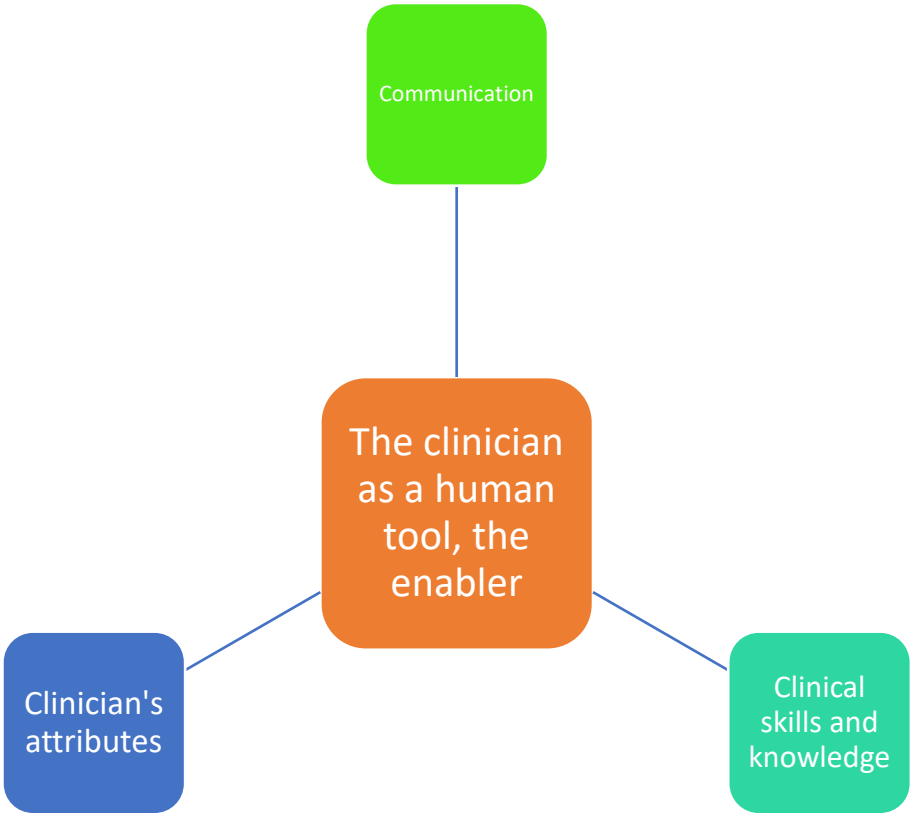

Figure 6.11 Study 4: Theme 3. The clinician as a human tool enables implementation of AAC interventions

The main aim of this focus group was to answer the question of how AAC specialist clinicians communicate when providing interventions. **Communication** was identified as one of the three sub-themes of this theme. The theme of communication was a strong theme with many references to communication in the data set.

There was reference to the clinician's ability to use communication to support interventions in a general sense. This includes the use of facial expression, the eyes, the body, pointing, and the use of tone of voice. The use of verbal and non-verbal communication were observed being used together:

Andy: …I'm thinking of instances where they [verbal and nonverbal communication] were literally used together (…) give a command verbally and physically you're pointing, showing that something is going to happen…

Meg also noted that the clinicians used rhythm and melody which she perceived as supporting the implementation of the intervention:

Meg: I don't know if you noticed but at some points they were using rhythm as well, at some points they were using melodic voice, repeating the same patterns, like 1, 2, 1, 2 (said with melody) or 'ready steady go' and it was helping the children to go into this pattern, it kind of helps, motivates and leads, continues on what the therapists were doing more

The participants perceived that the use of communication skills were adapted for the individual child in the moment as needed:

Andy: … verbal and nonverbal communication were very much intertwined and depends on the child's performance in that particular time.

Adaptation in communication included the clinician's non-verbal communication such as the position of the body, use of verbal cues, and the use of facial expressions which were specifically adapted for the child. Andy observed that the clinicians moved to the floor when a child refused to sit at a table:

Andy: Even where you place yourself (.) how close to the child, which level, at which height, sitting down if the child is just refusing to do an activity at the table and he sits down on the floor, physically positioning yourself on the floor in front of him.

In the quote below, Jo also refers to tone of voice and language input which were also perceived as being varied according to the child.

Jo: Even in terms of the language, it was more simple, in the sense they adapted according to, depending [on] the child obviously, there were some children who could, you know, take a bit more language and others, you know, needed a bit more, for example, more simple, concise instructions…

The participants noted that changes in how the AAC specialist clinicians communicated appeared to be linked to the children's sensory processing patterns. They specifically referred to adaptations in how the AAC specialist clinicians used touch, tone of voice and facial expressions. In the data extract below, Jo describes how on one occasion she observed the AAC specialist clinicians using an alerting tone of voice with a child who was in a low state of arousal:

Jo: …the level of alertness in the therapists' voice altered depending to to to the child, for example when she, like she said, emm, when J was feeling a bit low and and they had to use a a voice that was a bit more alert…

Meg also referred to the use of touch to calm or alert a child, as well as to the use of facial expressions which appeared to be related to the child's arousal levels:

Meg: …I mean at some points with some children they were using a lot of facial expressions and telling him 'look, you have to show me here' and partial prompting was evident but with other children who were kind of more on the go and alert they seemed to be, they were waiting more, poker face, expressionless faces, waiting for the child to initiate

A second sub-theme was **Clinical skills and knowledge**. The focus group AAC clinicians made reference to a significant number of clinical strategies which were used by the AAC specialist clinicians during the provision of interventions in the quantitative study and this included the need for goal setting. Despite the fact that the goal and study procedures were rigid, some decisions were taken in other

areas e.g., to find a reinforcer in order to get the child onside, how an activity is presented. Thus decisions were being made in an attempt to achieve the goals. Furthermore, these decisions were often taken in the moment. In the quote from Andy below, he noted that decisions were made on an individual basis to support the achievement of that goal:

> *Andy: …the work was to get him (the child) on board to get him to the goal. I think that really changed from one child to the other so we know maybe this child we know know exactly how we're gonna get him to the goal so let's get to it straight down (.) boom boom boom (.) get to the goal but for another child that needs more exploration more trial and error change things continuously on the spot, ufff (Maltese: indicates exasperation) (.) this is not working we need to change activity, we need to change place…*

Andy also stated that the teaching protocol designed for the study was used rigidly to achieve the goal of requesting with the VOCA despite the use of a range of strategies which were applied on an individual basis:

> *Andy: This is the goal, we have to be consistent towards, Ok, child led, very flexible, errr, we adapt, change but the consistency and repetition towards the protocol was there, underlying [it]*

While the AAC specialist clinicians were observed to use the treatment protocol rigidly, it was therefore other strategies which the focus group AAC clinicians perceived that the AAC specialist clinicians were making decisions about. These included strategies such as the use of expanding as is illustrated in the quote by Jo below:

Jo: …always labelling, they didn't just repeat if the child requested ball, 'ah, ok, ball' 'you want ball or yoghurt' not just labelling it, emmmmmm (.) literally anything that the child is going to ask for that I noticed.

Another example of a strategy which was discussed by the focus group AAC clinicians was the use of waiting expectantly as observed in the dialogue below:

Meg: They're looking at the child expectantly
Jo: Waiting
Meg: With an expectant look
Jo: Ehe (Maltese: indicates agreement)
Meg: For a gesture, a verbalisation, sometimes I feel during clinics we want to say a lot and we don't give time for the child to do much

Apart from the choice of strategies used, the focus group AAC clinicians referred to issues such as room preparation and reinforcers which were more practical in nature, yet also involved some degree of decision-making to ensure the optimal environment for the child to succeed in:

Meg: Preparation, they were always prepared beforehand, the room ready, so the child is going in and the child is there, everything is prepared.

The participants perceived that the AAC specialist clinicians provided interventions which consisted of activities which ran smoothly from one activity to another which was linked to the clinical experience of those who provided the interventions. Furthermore, they discussed how quickly the AAC specialist clinicians were able to adapt changing from one strategy to another, with speed when required:

Andy: One main thing that I observed is how quickly a therapist can shift from one technique to the other

Meg: Flexibility, you're saying?
Andy: Very much
Jo: Ehe (Maltese: indicates agreement), in terms of being flexible I saw that very much, I mean in one instance they are using one technique and then you know you see the child is responding in a certain way and OK, then they have to change it, and you know, according to how the child is responding…

The final sub-theme referred to the AAC specialist **clinician's attributes** within the intervention process. References were made to the AAC specialist clinician's ability to be flexible during AAC interventions. Flexibility referred to the provision of AAC interventions which were child oriented. This included adapting in the moment to ensure that the approach was child centred:

Andy: So they were adapting so quick, it was very evident to us, yet again looked very smooth to the student's eye, so they were doing so much work behind the scene to get everything adapted to the child, so child oriented.

Jo also referred to the AAC specialist clinician's flexibility which enabled adjustments as were required in the session. Furthermore, she observed that this was achieved by following the child's lead:

Jo: And I think even if you are going into a session keeping in your mind that you are going to let the child lead I think it was important as well for the therapist, it was very evident to be flexible, to adjust accordingly…

Flexibility was linked to how the AAC specialist clinician adjusted according to the child's sensory processing pattern. In the quote below, Andy described how for one of the child participants the AAC specialist clinicians adapted their interventions:

Andy: M was pretty straightforward, there was a bit of trial and error in the beginning until they identified what he needed [sensory processing interventions] but then it was very smooth, very direct.

Flexibility also referred to the use of personalised strategies in other communicative areas which were utilised in sessions: namely the provision of comprehension support within the intervention session. In the quote below, Andy described how verbal and nonverbal communication were used to support comprehension during an intervention session:

Andy: …you're like continuously assessing what's working with the child, so just giving a verbal 'go into the tunnel' didn't work, then add a physical prompt to it and actually move the child towards the tunnel, and then the second time around just with the verbal command only and see if the child can get on with that, so you're continuously varying the levels...

Reference was also made to the AAC specialist clinician's ability to provide an atmosphere of fun which was seen as a way to engage and entice the child.

Andy: sometimes one of the children didn't actually want to participate in the session and the therapist adapted the whole structured environment, into a more enticing fun environment, he usually likes the ball so let's entice him with the ball, play with the ball, play with the ball, so giving him, adapting the whole structure of the thing to get him enticed, to come with you, rather than getting him into the activities.

Persistence was also identified as a clinical attribute for working with children with ASC. The focus group AAC clinicians talked about how the AAC specialist clinicians continued to change activities to ensure that the intervention goal was achieved. Andy described this in the following quote:

Andy: I mean the sessions were planned individually according to the child and some sessions had to change, we know ASD, you can have the child on a bad day and no matter what you plan you have to adapt and modify on the spot so the session, even the planning of the session did change and even some of the choices that were given had to be changed from one session to the other cos something didn't work…

6.8.3 Data reduction analysis

During the thematic analysis, the theme of clinician's communication was identified as a sub theme of the theme: *The clinician as a human tool, the enabler.* This was directly related to the original research question which concerned how AAC specialist clinicians communicate when providing AAC interventions and was therefore of particular interest. All focus group data which was coded for communication was therefore extracted and a qualitative matrix which includes the coded text were created (Guest et al., 2012). A second qualitative matrix was also created which included text which was coded for both communication with specific references to sensory processing.

The results for the first matrix are displayed in Table 6.8. This matrix focusses on ways which the AAC specialist clinicians used their communication skills during the delivery of AAC interventions. Communication skills in their broadest sense were considered to be adapted for individual children. They were also, however, adapted according to child performance. References were also made to the way the AAC specialist clinicians used their bodies with change of position being made according to child's needs, for example, in one quote below, the focus group AAC clinician makes reference to how the child chose to sit on the floor and the AAC specialist clinicians adapted their position in the same way thus allowing the activity to be child led. Tone of voice was also used differently within the AAC interventions and this was perceived to be in relation to the child. Their appeared to be a spectrum of how tone of voice was used: from soft, mellow, and smooth to loud and assertive. The use of verbal cues was considered to be inconsistent

because it was dependent on the child's performance. Language input which was tied to how instructions were given, the complexity of instructions and the words chosen was also perceived to be varied for each child and appeared to be tied in to the child's comprehension levels.

Table 6.8 Data reduction matrix 1: Data arranged by quotes relating to areas of communication

Communication	***Quote***	***Comparative analysis***
Communication in general	Andy: verbal and nonverbal communication were very much intertwined and depends on the child's performance in that particular time	Not possible
	Andy: There was also adaptation in the communication with the child	
Clinician's body	Andy: Even where you place yourself (.) how close to the child which level, at which height, sitting down if the child is just refusing to do an activity at the table and he sits down on the floor, physically positioning yourself on the floor in front of him	Not possible
Tone of voice	Jo: I noticed as well the way they changed their voice, for example, on one particular occasion, we had a, one of the children was feeling quite low and the tone of voice was more, like, you, know, alerting so (.) and even calling his name (.) for example (.) before (.) you know trying to get him to do something	Complete convergence
	Meg: I don't know if we mentioned this but the way the instructions were being given sometimes they were loud and assertive, sometimes they were soft and mellow, and calm depending on the child's feeling	
	Andy: There was also adaptation in the communication with the child, for example there was an occasion where one of the therapists was assertive and the child was a bit surprised, and then you quickly adapt your tone, getting him back, you know smooth down your voice, smoothen down the activity and to get him back because he got a bit (.) we know how touchy they can be (.) so like he got all anxious at one bit, wanting to cry because he got a little fright (.) quickly quickly they calmed it down, adapt the voice, adapt their position, adapt the activity to get him calmed down	
	Jo: (Looking through notes) ah alright, I think as M said, I mean we were, emmmm the level of alertness in the therapists' voice altered depending to to to the child	
Verbal cues	Andy: Verbal cues that were going on (.) they were not consistent, it depends on the child's performance	Not possible
Language input	Jo: Even in terms of the language, it was more simple, in the sense they adapted according to, depending the child obviously, there were some children who could, you know take a bit more language and others you know needed a bit more for example more simple, concise instructions	Not possible

The results, presented in the second matrix (Table 6.9), demonstrate that not only did the AAC specialist clinicians communicate differently in the implementation of AAC interventions with different children but that this was perceived to be related to the child's sensory processing state. Participants' data referred to two broad categories of sensory arousal, hypo-reactive and hyper-reactive. There were a greater number of references to children who were hypo-reactive than for children who were hyper-reactive. References were made to how the AAC specialist clinicians used tone of voice, verbal cues, touch, and facial expression.

When discussing how the AAC specialist clinicians used tone of voice, all participants' references to children with a hypo-reactive pattern were in agreement. In general tone of voice was described as being 'alerting', 'assertive', and 'exciting'. More specifically the quoted texts indicated the use of high pitched voices with exaggerated intonation. One of the focus group AAC clinicians gave examples of the use of fun words such as 'wow'. The use of verbal cues with children who were in a low arousal state was also evident. Two of the focus group AAC clinicians specifically referred to the use of calling a child's name before an activity which they perceived as alerting. The focus group AAC clinicians also stated that touch was used to alert. Reference to the use of 'a lot of facial expressions' was also made in relation to a child with a hypo-reactive pattern.

For children with a hyper-reactive pattern focus group AAC clinicians made references to three areas of communication: tone of voice, touch, and facial expressions. The participants perceived that the tone of voice used was calming. They also noted that touch was used to calm. Facial expressions were perceived as expressionless and were used in conjunction with waiting more for the child to initiate.

Table 6.9 Data reduction matrix 2: Data arranged by quotes relating to areas of communication and sensory processing

Sensory processing pattern	***Area of communication***	***Quote***	***Level of agreement***
Hypo-reactive	Tone of voice	Jo: on one particular occasion, we had a, one of the children was feeling quite low and the tone of voice was more, like, you, know, alerting Jo: the level of alertness in the therapists' voice altered depending to to to the child, for example when she, like she said emm when J was feeling a bit low and and they had to use a a voice that was a bit more alert, so I think that was quite evident Meg: when the child was really passive then the tone tended to be more alert and more assertive Meg: With child 1, N it was, the child was very passive, so it's like we were saying before, the tone of voice was assertive, Andy: Verbal, I think it was used a lot to alert being used to alert Andy: N, his communication was much more alerting, higher pitched voice, much more exciting [hypo-reactive/sensory seeker] Jo: I noticed it almost in every session, the tone of voice when they are using a reward (.) whooooo [with exaggerated intonation], it was like (.) you know (.) kind of trying to get him (.) and even on one occasion when they were for example it was a bubble popping activity, emm, there was lots of wow [with exaggerated intonation]. You know, I think that helped the child to even you know, get him into the activity even more, so that I observed it, almost I think every session [N; hypo-reactive child]	Complete convergence
	Verbal cues; calling a child's name	Jo: on one particular occasion, we had a, one of the children was feeling quite low and the tone of voice was more, like, you, know, alerting so (.) and even calling his name (.) for example (.) before (.) you know trying to get him to do something Meg: Ehe (Maltese: indicates agreement) (.) something else which was interesting (.) they were alerting the children by calling their names	Complete convergence
	Touch	Jo: yes I noticed the use of touch [to alert a hypo-reactive child]	Complete convergence

		Meg: And physical (.) hekk (Maltese: translates 'that way') touch was being used	
	Facial expression	Meg: I mean at some points with some children they were using a lot of facial expressions [hypo-reactive]	Not possible
Hype-reactive	Tone of voice	Andy: Verbal, I think it was used a lot to calm a child, used to calm down a child on the go Meg: If the child was on the go and active the tone tended to be more calm	Complete convergence
	Touch	Meg: And physical (.) hekk (Maltese: translates 'that way') touch was being used	Not possible
	Facial expression	Meg: with other children who were kind of more on the go and alert they seemed to be, they were waiting more, poker face, expressionless faces, waiting for the child to initiate	Not possible

6.9 Discussion

This mixed methods study sought to answer four questions, each of which is addressed in turn below. The first two questions are discussed using the results of the SCED study which was predominantly quantitative. The caregiver social validity results which were analysed both quantitatively and qualitatively, and which formed part of the SCED, are used to support this discussion. The focus group analysis which was the qualitative strand is used to answer the third question. The final question was a mixed methods question and is therefore answered by interpreting the results of both strands together: the SCED and focus group results. The social validity results which provided an opportunity for parents to contribute are also considered when answering the mixed methods question.

Research question 1

The first question was whether the severity of sensory processing difficulty impacted on learning to use a VOCA to request. All four participants were able to learn to use the VOCA to request and the interventions provided were considered to be socially valid by all the caregivers who took part in the social validity assessment. Taking the results from the SSP to inform severity of sensory processing skills, Noah and James presented with sensory processing scores which indicated a probable difference in their sensory processing when compared to the sensory processing of typically developing children of the same age. This indicated that they had the least sensory processing difficulties of the four children who took part in Study 4. Lee and Max on the other hand presented with sensory processing scores which indicated a definite difference in comparison to the sensory processing skills of typically developing children thus indicating more severe difficulties in the area. Severity as measured by the SSP did not appear to be an indicator of how the children progressed in the SCED because Noah who had a score indicating a probable sensory processing difficulty took the longest to learn how to request with the VOCA. Max, on the other hand, who had the most severe sensory processing difficulties on the SSP assessment reached criterion in the least number of sessions with the lowest percentage of errors to criterion. In

view of this, severity of sensory processing difficulty as assessed by the SSP is unlikely to be an indicator of how a child might progress with learning to use a VOCA.

Research question 2

The next question focused on whether discrete sensory processing patterns impact on learning to use the VOCA. In this study, the four children recruited presented with a range of sensory processing patterns: hypo-reactive, fluctuating between hypo-reactive and hyper-reactive, as well as a child with a hyper-reactive sensory processing pattern with postural disorder. It is not possible, with any certainty, to state that the sensory processing pattern impacted learning to use the VOCA as the performance of each child might have been impacted by other child characteristics e.g., level of adaptive functioning. It is, however, possible to discuss the progress each individual child made in the study with particular reference to the sensory processing pattern and the modifications made to the AAC interventions which might have positively impacted on their ability to successfully learn to request with the VOCA.

Max, who presented with a hyper-reactive pattern with postural disorder presented with the greatest definite difference of all the children in the study when assessed on the SSP yet he learned how to use the VOCA in the least number of sessions. This child did not access any sessions in the sensory motor room as part of his intervention. Furthermore, for this child, the OT recommended a very structured environment that was provided in the AAC clinic in which Max was allowed some movement. In his case, therefore, only environmental modifications were required to provide him with the support he needed to learn to use the VOCA. The use of movement breaks are recommended to keep children alert and focused (Ashburner et al., 2014). It has been suggested that when this strategy is used it may support on task behaviour and this was clearly the case with Max as he came back to activities of his choosing without any prompting once he was allowed to move at will (Lang et al., 2010).

Lee presented with a sensory modulation disorder which fluctuated between hypo- and hyper-reactivity although he was predominantly hyper-reactive. Fluctuation in Lee's sensory processing state was evident both between and within sessions. Fluctuating profiles of arousal and emotion can present a challenge for children with ASC (Baranek, 2002; Prizant et al., 2003). In such instances, the focus of the sensory intervention was to provide Lee with sensory processing interventions which would support him to achieve an optimal arousal level. He therefore received sensory intervention in a sensory motor room prior to the AAC intervention session. Further sensory input in the form of environmental modifications was also embedded in the AAC session to further maintain an optimal level of arousal within the session (Ashburner et al., 2014). Lee took seven intervention sessions to reach criterion, this being the second longest of the four children in this study. It is possible that he required this number of sessions because of his fluctuating arousal state. Fluctuations in sensory arousal may have played a part in his ability to learn and to execute the skills learned within and between AAC intervention sessions as he was likely to be spending significant energy on trying to reach an optimal state of arousal. Additional explanatory factors for Lee's progress in the study may have been Lee's low Total Gesture score on the CDI-III which indicated that his early communication skills were at 10 months age equivalent. Furthermore, Lee's overall adaptive functioning scores were also low. Another explanation for the greater number of sessions which Lee required to learn how to use the VOCA to request was the use of photos on the display.

For Lee, procedural modifications were implemented to the SCED from session 3 because he did made very slow progress learning to use the VOCA in the early sessions. As Lee did not want to touch the photos which represented the reinforcers on the VOCA display, a change was made to the visual graphic symbols so the photos on the display were changed to PCS symbols. This was done because Lee was exhibiting signs of overattentiveness to the visual graphic symbols present on the display and it was thought that this could be due to the

use of photos. According to Liss et al. (2006), overattentiveness may be present in children with ASC and was also observed with two of the participants in Study 2. It is therefore possible that for some children symbols might be preferable as it is possible that some children with ASC are less likely to over focus on these kinds of visual graphic symbols.

Another consideration for Lee's variable performance, however, was the selection of reinforcers utilised for the study. The visuals were changed from photos to symbols but a change was also made to the vocabulary which was represented on the display of the VOCA. Specific vocabulary e.g. *PUZZLE* was changed to *PLAY* to allow Lee the option of asking for any play activity. With this adaptation, Lee could request any play, food, or drink activity within the intervention sessions. This change appeared to be helpful as Lee began to make progress after this change was made. This, then, raises implications for using the same reinforcers throughout a study as it is possible that a change in reinforcers might be needed as has also been noted by Gevarter et al. (2018). The use of more category based vocabulary, as was utilised with Lee, allows both child and clinician greater flexibility within intervention sessions.

Noah, who took the longest to learn to use the VOCA to request, presented with a hypo-reactive sensory processing pattern. Noah received interventions in the sensory motor room prior to the AAC interventions. Environmental accommodations were also implemented during the AAC intervention sessions. He also presented with motor difficulties which may also have contributed to the time needed to learn to use the VOCA as using the VOCA to communicate involves the use of motor skills. In the first four sessions, it was noted that he needed physical support to sit up and lift and reach with the device as he chose to play on the floor. This support was decreased over time, and in the social validity feedback, Noah's father also perceived that Noah was physically stronger. It is likely that there were some effects of the sensory interventions on Noah's motor skills. Mirenda (2008) suggests that motor impairments are much more common than

previously thought in children with ASC. It has also been stated that not only have the presence of motor skills deficits been underestimated but that the presence of these can significantly impact learning of skills and this could have been a factor in the time taken for Noah to learn how to request (Bo et al., 2016). Mirenda (2008) highlights the need to take motor skills into account when planning AAC interventions. In this study the use of the interventions provided in the sensory motor room may have impacted Noah's motor skills although this cannot be stated with any certainty as there was no specific assessment of these skills either before or after the study. Apart from the motor skills difficulties which Noah presented with, it is also possible that lower levels of adaptive functioning, as well as low levels of receptive language as measured by the VABS-2 may also have been contributing factors to the length of time required for him to acquire the skill of requesting with the VOCA.

The final child, James, presented with a sensory-seeking pattern. He received sessions in the sensory motor room prior to the AAC interventions with further environmental accommodations during the AAC sessions. He was the second fastest to achieve criterion achieving criterion within six sessions. He presented with the highest overall adaptive functioning score from this group of participants which may have supported him to achieve criterion. It is also possible that his prior experience of using PECS (he had achieved Phase III prior to the study) had an impact on his ability to learn to use the VOCA as he might have been able to transfer some of the skills learned with one mode of AAC to another.

Research question 3

The third question was focused on exploring the focus group AAC clinicians' perspectives of how the AAC specialist clinicians communicated during the provision of AAC interventions to the children who received AAC interventions in this study. This question is answered using the data from the focus group which was part of the qualitative strand of the study. Communication was identified as a subtheme within the third theme described in Section 6.8.2: *The clinician as a*

human tool, the enabler. The participants stated that communication between the clinician and child varied and was personalised to the individual child. Furthermore, the focus group data indicated that the focus group AAC clinicians considered communication to be an important aspect of forming a bond with the children and therefore achieving success in the AAC interventions. It is possible that the variation in how the clinician communicated may have been linked to the children's sensory processing patterns as the participants made references to differences in clinician communication which were linked to the child's sensory processing state e.g., they spoke about the use of a calming tone of voice with a child who presented with a hyper-reactive pattern. This is in keeping with suggestions for clinician communication made by Anzalone and Williamson (2000) who suggest that the use of animation may overstimulate a child who has a hyper-reactive pattern. Being mindful of how best to communicate with a child with ASC who has sensory processing difficulties could possibly be linked to AAC outcomes.

This subtheme of communication was strongly linked to the other two subthemes within the theme: clinician attributes, and clinical skills and knowledge. This suggests that the clinician needs to have particularly good communication skills in order to implement interventions effectively. While the focus group AAC clinicians considered communication within AAC interventions to be important, this could not be separated from the interventions themselves, or from the clinician's ability to provide fun within the interventions as communication with the child is an integral component in the intervention and the play scenario. Goldberg (1997) describes communication skills as a foundation to clinical skills which are necessary to build connections with clients. Furthermore, the use of communication skills is linked to in a wider range of skills which Goldberg (1997) refers to as typical of master clinicians. This includes the use of contingency thinking, in which a clinician is able to anticipate a child's response before it occurs thus enabling the provision of the most appropriate response. The author states that this is achieved when the clinician has a significant amount of expertise in the area. Between them, the

clinicians implementing the intervention shared over 30 years of intervention experience, much of which was specific to the area of AAC. It is worth noting that the AAC clinicians who took part in the focus group had much less AAC clinical experience than the clinicians who implemented the interventions, all under two years of clinical experience. While the difference in clinical experience may be considered a limitation of this study, the focus group analysis also serves to highlight the difference with which a more experienced clinician is able to provide interventions and that within the profession of speech and language therapy there are degrees of expertise (Roulstone, 2015). It also provides some food for thought as it is likely that local clinicians with less experience may find themselves in the position of having to provide such interventions. In such instances, questions might be asked about how less experienced clinicians can become more experienced, and the kind of support that is required for this to happen.

Another skill identified in the focus group data was the ability to implement the interventions consistently. This is also referred to as a trait typical of a master clinician by Goldberg (1997). The consistent implementation of the treatment protocol was a necessary component of the SCED yet it appears that the AAC specialist clinicians provided flexible interventions in other ways which included the use of strategies typical of speech and language therapists which are well documented in the research literature e.g., the use of waiting as a strategy which is prevalent in the Hanen programme (Pepper et al., 2004). Roulstone (2011) notes that while an intervention might be effective, it is the clinician who must implement it both skilfully and appropriately, thus the clinician could then be making decisions which will further support the intervention outcomes to be effective. Goldberg (1997) states that it is possible that for experienced clinicians, this decision-making becomes less apparent, becoming more automised. It is therefore possible that the clinicians implementing the interventions were making subtle adjustments to the interventions while still keeping to the treatment protocol. Clinicians appeared to be adapting their communication within the interventions but this was embedded in other decisions which were made in the

moment as required to meet the child's needs, possibly on a less conscious level. As Roulstone (2015) points out, merely implementing treatment without making adjustments is the act of a technician, and this may result in failure. An experienced SLT, on the other hand, demonstrates the ability to successfully implement interventions. In order to achieve this success, it could be necessary to make decisions such as the adjustments which were pointed out by the focus group AAC clinicians.

Research question 4

The final research question for this study concerned how the AAC specialist clinicians' communication may have explained the outcomes of the intervention study results. As all the children learned to use the VOCA within the sessions allocated, the intervention may be considered successful. The focus group data, however, indicated a difference both in how AAC specialist clinicians communicated with individual children and also according to the performance of the same child within a session. It is therefore possible that this individualised communication may have been a key component of achieving successful outcomes in the SCED. It is worth noting that the individualised communication occurred despite the AAC specialist clinicians' use of a specific prompting sequence as laid down in the SCED and which the focus group AAC clinicians noted was consistent. The references made to clinician communication were therefore further explored using a process of data reduction which served to further sharpen the data from the focus group (Huberman and Miles, 1994). The results in the first data reduction matrix indicated that the AAC specialist clinicians varied their communication in many ways, including their tone of voice, and their use of verbal cues. Language input in terms of complexity of language use was varied and may have been due to the need to match language to the child's comprehension skills. The AAC specialist clinicians were also noted to have changed their physical positions and this appears to have been done to allow child led interactions e.g., following a child to play on the floor if the child wanted to do this. This data reduction matrix provided evidence of generalised variability in communication

skills which then leads to a further question about whether the AAC specialist clinicians used their communication skills in ways which were more child specific to support the achievement of the goals set for the SCED.

The second data reduction matrix therefore explored the relationship between the AAC specialist clinician's communication skills and specific sensory processing patterns. The results, although limited, indicated that to a certain extent, the AAC specialist clinicians did vary their communication according to the child's sensory processing patterns. In general, references were made to two broad patterns of sensory processing; hyper- and hyporeactivity. The references made to communication with children who presented with a hypo-reactive pattern appeared to be the kind which could be described as alerting or stimulating e.g., the use of assertive, more exciting, high pitched voice with exaggerated intonation. The participants also made reference to 'a lot' of facial expressions. Touch was described as alerting but no further comments were made in terms of how this was done. It is possible that the communication described by the focus group AAC clinicians was used by the AAC specialist clinicians to support the children to reach an optimal level of arousal and attention, this would be in accordance with general intervention guidelines for children who present as hyper-reactive (Anzalone and Williamson, 2000). More alerting communication may provide the hypo-reactive child with stimulating input as the child needs arousing input in order for sensory input to be registered (Schaaf and Mailloux, 2015).

For children with a hyper-reactive pattern, analysis of the focus group data using data reduction indicated a picture of communication which was contrasting to that used with the children who were considered to be hypo-reactive. For these children, the AAC specialist clinician's communication was described as calming. Facial expressions were described as expressionless. This is consistent with suggestions for intervention which are typically calming in order to prevent sensory overload (Anzalone and Williamson, 2000).

Although the focus group AAC clinicians made no specific reference to clinicians' communication with the child who presented with a fluctuating sensory modulation disorder, there were comments which referred to changes in communication depending on the performance of the child. Watson et al. (2011) suggest that clinicians, in general, should be prepared to be flexible in order to meet the child's sensory response patterns rather than depending on a specific strategy, thus with this kind of sensory processing pattern the AAC specialist clinicians were possibly using strategies suitable for both hypo- and hyper-reactive sensory processing patterns.

While the original question focussed specifically on how the AAC specialist clinicians used their communication to explain the intervention results, the focus group data clearly indicated that communication was intertwined with the use of a range of other clinical skills and clinical attributes. In view of this, it is not possible to discuss the use of communication skills without considering the use of other clinical strategies and how these were used. Flexibility and adaptability appeared to be a significant component of how interventions were implemented. Almost certainly, understanding the sensory processing pattern of each individual child added a new dimension to how the AAC interventions were provided. It impacted on the clinicians' communication, their ability to form bonds with the child, and the provision of activities which were used for teaching the child to use the VOCA.

In this study, assessment of sensory processing skills provided information upon which the sensory processing interventions could be planned. These were then integrated with the AAC interventions to build a more comprehensive AAC intervention plan. Assessment of other skills, such as early social-communication skills (using the CDI-III), comprehension, expression and motor skills (using the VABS-2) provided other valuable information and together with the sensory processing assessment results resulted in interventions which were personalised for each child. This resulted in a plan that tackled the child's needs holistically. This is consistent with Iacono and Caithness (2009) who state that assessment is

required to inform interventions. Despite the initial planning of the interventions according to the results of the assessment, clinicians needed to apply further knowledge and flexibility to first connect with the child, and then to choose strategies according to the child's presentation on the day. In order to be child led, the AAC specialist clinicians manipulated a range of subtle variables such as the use of waiting, which were not described in the SCED method, but which possibly contributed to the achievement of successful outcomes resulting in individualised interventions. Mirenda (2009) suggests that successful implementation of AAC interventions is not just about the AAC hardware, but also about how the AAC device is taught. While the treatment protocol was followed consistently, the focus group participant analysis suggests that there was more to implementing the AAC intervention than the teaching protocol itself.

Good communication skills and flexibility have been referred to as some of the personal characteristics of the SLT which can contribute to positive outcomes. In addition, however, the clinical attribute of persistence was also identified in the focus group data. This was interesting as it was also identified in the social validity results, with parents noting that the AAC specialist clinicians were persistent in their intent to achieve the goal of requesting with the VOCA with their children. It has been suggested that clinicians could present with skills and attributes which are exclusive to the area they work in. It could be that that the clinical attribute of persistence was identified in both sets of data because for children with ASC the difficulties in the area of social communication coupled with sensory processing difficulties meant that the AAC specialist clinician had to be more persistent to establish a bond with the child. It could also be that the parents of the children had previously experienced SLT interventions which were not successful with their children and that this was perceived as a lack of persistence on the clinicians' part.

The results of this study extends the previous studies (Studies 1, 2, and 3) in several ways. Firstly, it demonstrates that a further four children could be taught to request using the protocol developed for Study 1. It provides further insight

into how sensory processing patterns may impact on learning to use a VOCA to request. Similar to the results of Study 1 and to a certain extent Study 2, the children with a hypo-reactive profile needed a greater number of sessions and were delayed in learning to use the AAC device to request in comparison to the other participants. Furthermore, it provides some initial evidence that successful interventions with beginning communicators with ASC are to some extent dependent on the human component and go beyond both the choice of AAC hardware and the treatment protocol. The interventions extend to include the way the clinician bonds with the child, the way interventions are implemented, flexibility, and persistence: all of which are tailored to the individual child. Moreover, this study gives some preliminary evidence that clinicians should adjust their communication skills in accordance with the child's sensory processing pattern when providing AAC interventions.

Limitations

This study does present with some limitations. In relation to the quantitative strand, only requesting was taught as a communicative function, and the children were only taught to request from a choice of four visual graphic symbols. Furthermore, the study lacked a generalisation phase so it is not known if the children would have been able to transfer the skills learned in this study to request from other communicative partners and in other situations such as at home and in school. The main limitation of the qualitative strand was the use of live observations by the focus group AAC clinicians which to a certain degree may have been influenced by the researcher herself as she implemented the interventions. Had it been possible to make video recordings, more objective results on how AAC specialist clinicians communicate during AAC interventions would have been obtained. The data was also limited as it was based on focus group AAC clinicians' observations of just two sessions with each child.

Conclusions

This study served to demonstrate that another four children with ASC and sensory processing difficulty could be taught to request using a VOCA using an intervention protocol which was considered to be socially valid. All four children received individualised sensory processing interventions which were coupled with the AAC interventions to support them to learn to request. The study also demonstrated the variability which is evident in the children's ability to learn to request and which is likely linked to child characteristics. In particular, this study provided further evidence that children who present with hypo-reactive sensory patterns may be more likely to take longer to learn to use a VOCA for communicative purposes although taking into account adaptive functioning, early communication skills is also important. The focus group served to identify some patterns of how the AAC specialist clinicians communicated during interventions for children with differing sensory processing patterns. It also served to provide information on other clinician attributes such as the need for decision-making skills, flexibility, and persistence which extended beyond communication but were closely tied to it and would appear to be as important.

Chapter 7. General discussion

The overall purpose of this research was to explore decision-making when providing AAC interventions to children with autism spectrum disorder (ASC). The overarching research question was:

> How can SLTs improve outcomes when making decisions for augmentative and alternative communication (AAC) interventions for children with ASC?

In order to answer the overarching research question, three sub questions were set as follows:

1. How do the two visual display layouts: a visual scene display (VSD) or a grid display impact on how minimally verbal children with ASC learn to request using a VOCA?
2. How do the individual characteristics of children with ASC impact learning to request with a VOCA?
3. What aspects of AAC interventions should be considered during the decision making process for children with ASC?

7.1 Summary of main findings

This PhD consisted of four studies and utilised a mixed methods approach to answer the overarching research question. There were three SCED studies in which a total of 12 minimally verbal preschool children, four in each study, diagnosed with ASC were taught to request preferred items using a VOCA within a single case experimental design (SCED: Studies 1, 2 and 4). In Studies 1 and 2, the children were taught to request using two display layouts: a VSD and a grid display, thus enabling the researcher who was a speech and language therapist (SLT) to make comparisons between the two vocabulary layouts. Study 2 was followed by a qualitative study, Study 3, which was an interview with the occupational therapist (OT) who was also involved in the implementation of interventions in Studies 1 and 2. The purpose of the interview was to obtain this

person's opinion of how AAC interventions could be provided to children with ASC. Taking into consideration the results of Studies 1 and 2, and the results of the OT interview, the final SCED study (Study 4) was then designed to teach four new participants to request using only a grid display. Study 4 was designed from the outset as a mixed methods study and the final SCED study was therefore combined with a qualitative strand, a focus group comprising of clinicians (two SLTS and one OT) who observed some of the sessions in the SCED strand of Study 4.

Specifically, in Study 1, which involved a comparison of a VSD with a grid display, two of the participants (Simon and Jack) reached criterion on the use of both display layouts. The other two participants (Nathan and David) did not achieve criterion within the allocated intervention timeframe. Furthermore, Simon achieved criterion in the grid display condition before the VSD condition. Jack, on the other hand, took one session longer to achieve criterion in the grid display condition. For both participants, criterion was achieved first in the condition in which intervention started. In order to explain the results, individual child characteristics were reviewed and it was identified that Nathan and David presented with lower levels of communicative and representational skills, lower comprehension scores, and lower adaptive functioning scores than Simon and Jack. Furthermore, on reflection, sensory processing difficulties were also evident in Nathan's and David's profiles but not in Simon's and Jack's.

Study 2 was a systematic replication of Study 1 procedures with the addition of the implementation of sensory interventions for all phases of the study. This was because the participant criteria for inclusion was extended to include a diagnosis of sensory processing difficulties as well as ASC. The number of treatment sessions was extended to support achieving of the learning criterion. Additionally, parents were involved in an assessment of social validity after the intervention was implemented, thus Study 2 was a mixed methods study. In this study, three participants achieved criterion in both visual displays. Mark achieved criterion in

the grid display first, Sam and Andy achieved criterion in both displays in the same number of sessions. Zak achieved criterion in the VSD only although he achieved criterion in the grid display in the post-intervention phase. Parental opinion was either in favour of the grid display or they did not believe that the organisation of the vocabulary made a difference to their child's progress in the study.

Study 3 was designed to gain an understanding of the OT's opinions of providing AAC interventions to children with ASC. The results of the interview provided support for the use of grid displays over VSDs during AAC interventions. It also provided some explanations of how sensory processing could influence the outcome of AAC interventions. Furthermore, the OT stated that in her professional opinion the need to be able to bond with the child, also referred to more formally as the 'therapeutic alliance' underlies successful interventions. This, she considered to be a foundation skill for working with children with ASC in a general sense.

Study 4 consisted of two strands. The SCED strand in which four more children with ASC and sensory processing difficulties were taught to request using a VOCA with a grid display. Parental opinion of the intervention was solicited using an assessment of social validity which combined both qualitative and quantitative data analysis. In addition, the qualitative strand was a focus group made up of clinicians who observed some intervention sessions prior to the focus group meeting. The focus group was included to gain the clinicians' perceptions of how clinicians connect with children with ASC during the provision of AAC interventions. All four participants in the SCED accessed sensory interventions throughout all phases of the study. The sensory processing interventions were tailored to the participants' individual sensory processing patterns. All participants learned to request using the VOCA in the allocated timeframe. The focus group results indicated that they perceived that the AAC clinicians' communication during the interventions was varied according to individual participants and this was perceived as being related to their sensory processing patterns. Communication

was, however, perceived as one of other factors of how the clinician influenced the outcomes of successful AAC interventions as communication was also strongly connected to the clinician's skills of being able to bond with the child with ASC. The analysis of the focus group data also indicated that the clinician acts as a human tool, an enabler of successful AAC interventions which impacts on the decision-making process in a number of ways. The heterogeneity of children with ASC was considered to be a driver of how decisions are made.

The following sections of this chapter will discuss the findings in terms of the three sub questions above. The clinical implications of the findings, strengths and limitations of this research, and directions for future research will also be included.

7.1.1 Choosing visual display organisation layouts

The first research question referred to how the organisation of vocabulary through the use of a VSD or a grid display impacts on the acquisition of requesting skills using a VOCA. This question specifically refers to the decision-making process a SLT would make during the assessment process. Two of the children in Study 1 (Nathan and David) failed to achieve criterion in either display and therefore a comparison of the impact of the two displays could not be made for these participants. The results for the other six participants from Studies 1 and 2, however, suggest that there was minimal difference in the efficiency of learning to request using each display layout. Two participants (Sam and Andy) achieved criterion in the same number of sessions for both displays. Two other participants (Simon and Mark) achieved criterion faster in the grid display while Jack was faster with the VSD. Zak, achieved criterion in the VSD only although his results in post-intervention clearly indicate that he would have achieved criterion in the grid display had further intervention sessions been allocated. When there was a difference in acquisition in one display over another, this was by one or two sessions. It was possible to calculate effect sizes using percentage of non-overlapping data (PND) for all eight participants including Nathan and David who did not meet criterion in either the VSD or the grid display conditions. For six

participants, the effect size was the same in both conditions. For the other two participants, Sam and Andy, higher PND values were evident in the grid display indicating a greater effect of intervention provided in this condition.

Taken together; the number of sessions to criterion with PND values, the findings of Studies 1 and 2 appear to run counter to the early published research which hypothesised that VSDs could present advantages over grid displays particularly with children who are beginning communicators e.g., Drager et al. (2003), Drager et al. (2004) and Light et al. (2004) as there did not appear to be any particular advantage for learning to request using one display over another. In those particular studies, however, the children were not taught to request desired objects. All three studies focussed on teaching children how to locate vocabulary. It is possible that for the children who took part in Studies 1 and 2, requesting of a desired item served to act as a motivator which goes beyond solely locating vocabulary. Furthermore, those studies were carried out with typically developing children as participants. It was some years later that it was further hypothesised by Shane (2006) and Shane et al. (2012) that the proposed advantages of the VSD could also be specifically relevant to children with ASC. To date, however, only three published studies have directly compared the use of differing display layouts on a VOCA with children with ASC. Gevarter et al.'s (2014; 2017; 2018) studies compared the effects of a VSD and a grid display on learning to request although the results of Studies 1 and 2 in this research run counter to those presented in these studies. In their first study, Gevarter et al. (2014) concluded that AAC display and design elements could influence the acquisition of requesting skills. Specifically, the study indicated that the VSD could be more efficient for children with ASC. The display utilised for the VSD was, however, limited to a visual of a single reinforcer in isolation which rendered the display more like a grid display (Ganz et al., 2015). In the second study by Gevarter et al. (2017) the participants learned to request with the VSD and grid display programmed with four hotspots, similar to the studies presented in this thesis. It was concluded that they progressed more rapidly and with fewer errors in the VSD condition, but the

authors also acknowledged that it is likely that the use of symbols in the grid condition as opposed to photo stimuli for the VSD condition may have had an impact on the results. Gevarter et al. (2018) also used photo stimuli in the VSD condition and symbols in the grid display condition in their third study. The difference in the visual representations meant that the iconicity of the visual representations used in the two conditions was not the same. It is possible, therefore, that the use of photos, which are considered to be highly iconic in terms of vocabulary representation, may have better supported the participants to understand the visual representations of the vocabulary in the VSD condition rendering this condition more advantageous than the grid display condition (Mirenda and Locke, 1989).

In order to understand how and why the current results differ from these studies, it is necessary to understand in what way Studies 1 and 2 build on the Gevarter et al. (2014; 2017; 2018) series of studies. Firstly, in Studies 1 and 2, the same AAC application (app) was used for both intervention conditions to ensure that any differences in results would be attributed to the display and not to some other aspect of the AAC app. In Gevarter et al.'s (2014) study, different apps were associated with the different treatment conditions thus attributes of each app may have influenced the outcomes beyond the organisation of vocabulary on the display. In Gevarter et al.'s (2017; 2018) second and third studies, however, a change was made and the same app was used for all conditions. Secondly, in Studies 1 and 2 of the present research, photo stimuli were used in both intervention conditions to ensure that iconicity of the visuals did not interfere with the results as this may have been a factor which impacted the outcomes of the Gevarter et al. (2014; 2017) studies which utilised both photos and symbols for different conditions. A third difference between Studies 1 and 2, and the Gevarter et al. (2014; 2017; 2018) studies is in the research design utilised. A multi-element design in which requesting of the same reinforcers was taught in all treatment conditions was used in the Gevarter et al. (2014; 2017; 2018) studies. Studies 1 and 2, on the other hand, utilised an adapted alternating treatment

design (AATD) in which two sets of reinforcers were created for each treatment condition thus different reinforcers were utilised for each of the treatment conditions. Wolery et al. (2014) state that the use of the AATD as a design overcomes many of the limitations of multi-element designs particularly with respect to the separation of treatment issue which is typically prevalent in the multi-element design utilised by Gevarter et al. (2014; 2017; 2018). This is important because it means that the authors are unable to solely attribute changes in requesting behaviour to one kind of display (Holcombe et al., 1994).

As a group, the results from Studies 1 and 2 fail to present sufficient evidence that one display layout provides an advantage over the other. To some extent, this is in keeping with the results of a recent study by Barton-Hulsey et al. (2017). This study demonstrated no significant difference between either comprehension or expression of language on either type of display when three children with developmental and language delays were taught 12 new symbols using both display layouts. Apart from the results of the two SCEDs, however, there are other results from Studies 2 and 3 which could be taken into consideration when assessing the outcomes of the interventions provided by these studies.

Firstly, Study 2 was altered to include assessment of social validity with carers in order to explore their perceptions of the interventions and displays used. In doing so, it was possible to gain an opinion of the visual displays that go beyond the clinical results of the SCEDs. This ensured that carers' opinions are also taken into consideration in the final evaluation of the outcomes of these studies (Blackstone et al., 2007). Assessing social validity is important as methods which are considered to be valid are more likely to be embraced by consumers (Schlosser, 1999b). The inclusion of this measure presents a different perspective, that of the caregiver who is a significant stakeholder in the implementation of AAC interventions for the client group who participated in these studies. To date, none of the published studies which have utilised a VSD as a treatment condition have included a measure of social validity although it is recommended that parents are

involved in making decisions about which display to use (Ganz, 2015; Barton-Hulsey et al., 2017). This is consistent with a model of evidence-based practice (EBP) within the field of AAC which states that the views of caregivers as indirect stakeholders should also be taken into consideration as one element of this process (Schlosser and Raghavendra, 2004).

Parents of the participants in Study 2 generally perceived that the grid display was easier to use, and that their children were less likely to make errors using this kind of display. Their perception of greater errors made with the VSD is important because comparison of errors to criterion can also be used as a valid measure of efficiency in conjunction with number of sessions to criterion (Schlosser, 1999a). Parental opinion of errors was generally consistent with the results of Study 2. Parents also perceived the VSD as cluttered and disorganised which they felt might negatively impact on accurate access of the vocabulary on the display. When the results of all eight children who participated in both studies were examined for percentage of errors to criterion, Jack was the only child who made a greater number of errors with the grid display. In Jack's case this could be explained by the order of treatments as Jack commenced intervention with the grid display condition and this may have resulted in a greater number of errors. Given, the results of Studies 1 and 2, a grid display could be a better option with which to commence AAC intervention, as it is more likely to lead to decreased errors and therefore greater accuracy of requesting from the outset.

Apart from the caregiver social validity results, the results of the OT interview (Study 3) can also be taken into account. The OT was present for all sessions provided in Studies 1 and 2 and therefore her opinion is valid from the perspective of a clinician being asked to implement AAC interventions. On the whole, the OT's opinion of the display layouts converged with the results of Studies 1 and 2 as she did not perceive any major difference between them. Furthermore, she noted that for those children with difficulties in the area of visual scanning, the grid display could be more helpful. This is interesting as Barton Hulsey et al. (2017) refer to

the possibility that visual perception skills could impact on learning to use AAC devices with different displays. Overall, the OT did not perceive the type of visual display utilised as being significant in achieving the skill of requesting as defined in these studies, and this is also consistent with the results of Studies 1 and 2 as when children failed to achieve criterion this was generally in both conditions. In some respects, her opinion of the VSD resonates with the outcomes of Thistle and Wilkinson's (2015) survey study in which SLTs who worked with young children responded that they used VSDs less than 25% of the time. These authors state that the results indicate that the SLTs used the grid displays most of the time and propose that this may be due to lack of awareness of VSDs but it is possible that SLTs, similar to the OT in this study, may not feel that the VSD presents the child with any specific advantage over a grid display.

One further factor which could be considered when determining whether to use a VSD or a grid display for a particular child is what each method of vocabulary organisation is capable of achieving from a communicative perspective in the longer term. Abbott and McBride (2014) note that devices with pre-programmed phrases such as those which are typically found in a VSD may constrain a child from learning to build sentences and communicate novel ideas. The authors refer to the communication level of the child stating that for children who are functioning at lower levels and require partner support, a VSD could be a suitable option. In Studies 1 and 2, there were children who were functioning at below 8 months in terms of social-communicative skills, as evidenced by the McArthur-Bates Communicative Development Inventories-III (CDI-III) assessment results, and yet these children were able to learn to request using both displays. It is, however, possible that there is another profile of child with ASC for whom the VSD would be absolutely necessary although this did not reveal itself in either Study 1 or Study 2, for example, a child with lower adaptive functioning levels and lower comprehension skills than that of the 12 participants who took part in the three SCEDs presented in this thesis. In these studies all participants were able to learn to communicate requests with both displays at some level even when criterion was

not achieved. Importantly, there did not appear to be any real difference in the rate of learning between the two layouts for any participant and therefore the practice of commencing AAC intervention with a VSD appears questionable for children with ASC. The use of a VSD may ultimately constrain a child's language growth and if we are to 'approach the individual with the assumption that, "here is a person with ASD who is certainly capable of learning to communicate fully and well,"…' (Mirenda, 2008 :225), then it would appear to be a sensible option to commence with a system which is capable of generating novel sentences from the outset. The choice of visual display within the context of decision-making for this client group therefore, may not be as important as previously thought. The clinician may need to additionally consider other factors to be discussed below when making clinical decisions for this client group.

7.1.2 Impact of individual characteristics of children with ASC

The second question which this thesis set out to answer was how the individual characteristics of children with ASC impacted their progress in learning to use a VOCA for requesting. Recent research has indicated that child characteristics play an important role in making recommendations for AAC devices, for example, Murray et al. (2019). Gevarter et al.'s (2013b) systematic review of different AAC systems has also indicated that their effectiveness for children with ASC is likely to be influenced by child characteristics. This is important because understanding how child characteristics impact the effectiveness of a specific intervention is one aspect of the decision-making process (Schreibman, 2000; Ganz et al., 2010).

Recently, however, it was reported that further research is required to address the gaps in knowledge of child characteristics of children with ASC and how this impacts on our decision-making within the field of AAC and therefore the state of research evidence is limited (Ganz, 2015). While it is acknowledged that the results of the three SCEDs reported in this thesis have limited generalisability, the results do provide some evidence about the characteristics of children with ASC which could be considered when making decisions about AAC interventions.

In Studies 1, 2 and 4, all participants who had a diagnosis of ASC and were minimally verbal, were provided with the same AAC intervention in order to learn to request with the VOCA. Taking their performance in the grid display condition as a guide, the results indicated differences in the number of sessions that it took for them to acquire the skill; ranging between three and nine sessions. In the remainder of this section, therefore, the consequence of individual differences between the participants is considered as a possible contributor to the difference in results. This information could be useful to inform how the intervention could be made effective for different individuals with the same characteristics (Wolery, 2013), and has been cited as the most obvious source of variability in outcomes (Schreibman, 2000).

In Studies 1, 2 and 4, all participants were assessed in the following areas and the impact of each of these will be discussed below:

- Autism severity
- Adaptive functioning
- Early communication and representational skills
- Sensory processing

Severity of autism symptoms did not appear to be an indicator of progress in these studies because all children scored as having a high level of autism-related symptoms. The exception was Jake who scored as moderate. It may be of significance, however, that Jake was one of the children who was the fastest to achieve criterion, although Simon, who had a higher level of autism related symptoms also learned to use the VOCA to request in the same number of sessions. It is possible that children who have lower levels of autism symptoms may progress faster in AAC interventions although this is likely to be influenced by other child characteristics which will be discussed below.

In terms of adaptive functioning, Andy, Noah and Lee who took the longest to achieve criterion were those with the lowest composite scores on the Vineland

Adaptive Behaviour Scales-2 (VABS-2). Similarly, Nathan and David who failed to achieve criterion in the allocated six sessions of interventions also had low scores. In these studies, therefore, it seems that as adaptive functioning scores decreased, a greater number of sessions were required to learn to use the VOCA. This is similar to Ganz et al.'s (2011) findings which suggest that overall functioning may be a mediator in the learning of aided AAC devices, thus children with lower adaptive functioning levels are likely to require more sessions of intervention. There were, however, exceptions to this within the group of participants who took part in the studies. Zak, who took nine sessions to achieve criterion in the VSD presented with a slightly higher adaptive functioning score than some of the other participants. In his case, however, there were two further possible characteristics that might have impacted on his progress in the study: firstly, Zak presented with the lowest receptive language scores on the VABS-2, secondly, the sensory processing difficulties he exhibited were severe and may have presented him with a further challenge to learn to use the VOCA.

As it has been suggested that receptive language is a naturally essential component of learning to use AAC devices (Romski and Sevcik, 1988), the relationship between receptive language and the children's progress in the study was also examined. Receptive language as assessed on the VABS-2 indicated that those children who had the highest scores learned to use the VOCA fastest although the children with the lowest receptive scores were not always the children who took the longest to achieve criterion. Furthermore, the children who did not achieve criterion were not the children who had the lowest receptive language scores. For these children it is possible that other child characteristics impacted on their progress, for example, additional sensory processing difficulties, or the presence of challenging behaviours. Moreover, in using the VABS-2, receptive language levels were determined by parental report. An alternative assessment of receptive language e.g., the Preschool Language Scale-5 (Zimmerman et al., 2011) would have provided a more finely graded receptive

language score and therefore a more definite relationship between receptive language levels and learning to use an AAC device might have emerged.

All participants' early social-communicative skills were assessed using the CDI-III. Specifically, the sub-section Total Gestures age equivalent score which reflects early social-communication skills appeared to be more predictive of how the participants would progress in the study than the comprehension score from the VABS-2. The participants who were fastest to achieve criterion were those who had the highest scores on this section. Conversely, those who took the longest to learn to request using the AAC device had the lowest scores. Furthermore, those who did not achieve criterion, Nathan and David, had even lower scores although it is acknowledged that these children received less sessions of intervention and sensory processing interventions were not implemented in Study 1. For the children who had existing social-communication skills at higher levels, it is possible that the VOCA served to augment already existing communication skills. These children, for example, had well developed pointing skills at the outset of the study. For children who had lower scores in this area, the AAC intervention may have served to teach about the process of communication in the early sessions. This may then have necessitated a greater number of sessions and contributed to a higher percentage of errors in each session.

The assessment results of early social-communication skills, autism severity and adaptive functioning are often described in published research which has focussed on children with a diagnosis of ASC who require AAC interventions e.g., Ganz et al. (2010) utilised the Autism Diagnostic Observation Scale-2 (ADOS-2) results to indicate autism severity in their study. Another example is van der Meer et al.'s (2013) study in which the adaptive functioning levels of the participants was described using the VABS-2 results. No published research was found, however, in which sensory processing measures were also included to describe the sensory processing abilities of participants with ASC who required AAC interventions. It has been suggested in a general sense that underlying sensory processing patterns

could be useful for determining what interventions work and for whom (Uljarević et al., 2017). In their chapter on assessments for AAC, Iacono and Caithness (2009) refer to issues with sensory processing difficulties which may be prevalent in this population and may impact on intervention outcomes.

The assessment of sensory processing using the Short Sensory Profile (SSP) was included in the baseline phase of Study 1 as it was felt that the clinically observed sensory processing difficulties of two of the participants might impact on their ability to respond to the AAC interventions which were provided. As these two participants then failed to achieve criterion, the recruitment criteria was altered for Studies 2 and 4 to ensure that the next eight participants also had sensory processing difficulties in conjunction with their diagnosis of ASC. The change in recruitment criteria was implemented in order to explore the influence of sensory processing difficulties which are highly prevalent in children with ASC (Leekam et al., 2007; Schoen et al., 2009).

Sensory processing theory states that sensory integration is the process of organising sensory inputs so that the brain produces a useful body response and learning can take place when the functions of the brain are balanced (Ayres and Robbins, 2005). This theory hypothesises that when there is difficulty with the processing and integration of sensory information, this affects behaviour and learning (Ayres, 1972). Evidence suggests that sensory processing difficulties in children with ASC is a significant factor which affects participation in daily activities (Tomchek et al., 2015). Furthermore, Jordan and Brown Lofland (2016) state that when sensory input is not integrated purposefully and usefully, it may impact on the child's ability to respond consistently and that this extends to the ability to communicate, particularly for a child with ASC. In the research presented in this thesis, it is proposed that sensory processing difficulties may also impact on learning to use an AAC device and that this may then have consequences for decision-making.

In the three SCED studies, sensory processing was assessed using the SSP. This assessment test yields a composite score which is compared to typically performing peers. When the SSP scores of each of the 12 children was compared to the number of sessions to criterion there did not appear to be a relationship between the scores obtained on the SSP and the number of sessions. The exception to this was in Simon and Jake's results, whose sensory processing was comparable to typically developing peers, and who learned to use the VOCA to make requests in the shortest number of sessions. Zak, who was the child with the most definite difference in his sensory processing (when compared to typically developing peers) was the child who took the longest to learn to use the VOCA. Sam, however, who had the next lowest SSP score learned to use the VOCA in just four sessions indicating that despite significant differences in sensory processing when compared to typically developing children he was able to learn to use the VOCA relatively fast. This could be because the environmental accommodations which were used as strategies to support sensory integration during the AAC interventions were effective for Sam in a few sessions. He was therefore able to achieve self-regulation relatively quickly and this supported him to learn to use the VOCA for requesting. For Zak, on the other hand, a greater number of sessions consisting of the AAC intervention combined with sensory processing interventions may have been necessary for him to achieve self-regulation which in turn supported him to learn to use his AAC device.

From the data, it could be concluded that when children with ASC do not have sensory processing difficulties it might be expected that they would learn to use a VOCA faster than children with ASC who do have sensory processing difficulties. It would appear, however, that beyond this, the SSP score in isolation might not be an accurate predictor of how sensory processing difficulties impact learning to use a VOCA.

Given the lack of a relationship between the SSP composite score and learning to request with the VOCA, the overall sensory processing pattern was also compared

to how children progressed in the study. Examining sensory processing patterns in relation to learning to use the VOCA is important as understanding sensory differences and their impact on learning can support the clinician to tailor the intervention approach to the individual child (Tomchek et al., 2015). Each child was therefore classified as having either a predominantly hyper-reactive, hypo-reactive or sensory-seeking pattern and this was described/defined in order to determine the interventions required to target the sensory processing difficulty. As a group, the predominant sensory processing patterns were that of hypo-reactive and sensory-seeking which is consistent with findings from Patten et al.'s (2013) study which reported that nonverbal children with ASC were more likely to exhibit these patterns than a hyper-reactive pattern. When the predominant sensory processing pattern was compared to number of sessions to criterion, more definite trends in the acquisition of requesting using the VOCA were identified.

As stated above, those children who presented with sensory processing abilities similar to typically developing peers (Simon and Jake in this research) were the fastest to learn to use the VOCA.

The results suggest that the children who presented with a predominantly hypo-reactive pattern: Andy, Noah, and Zak, took the longest to learn to use the VOCA to request as they required over eight intervention sessions. It was noted that children who presented with a hypo-reactive pattern were least likely to achieve correct responses in their first sessions. While no relevant research was found which specifically focuses on the relationship between learning to use AAC devices and sensory processing patterns, the literature does indicate that children who are hypo-reactive are more likely to have difficulty with language and communication skills than children with other sensory processing patterns (Liss et al., 2006; Watson et al., 2011; Tomchek et al., 2015; Williams et al., 2018). In a later study, the conclusions drawn by Patten et al. (2013) echo similar results but extend the findings to conclude that children with a hypo-reactive pattern are also more likely to be nonverbal. The authors suggest that the difficulty with attention orienting

and shifting prevalent in a hypo-reactive pattern could possibly constrain communication development. Tomchek et al. (2015) hypothesise that this group of children may miss out on opportunities for language learning. It is possible, therefore, that this might also extend to learning to use a VOCA, as hypo-reactivity may lead to decreased opportunities for learning to use the VOCA although further research would be required to confirm this (Patten et al., 2013; Tomchek et al., 2018).

Sam and James who presented with a sensory-seeking pattern took between four and six sessions to learn to use the VOCA. This was less than that required by the children who presented with a hypo-reactive pattern, indicating that this group of children is possibly, for some reason, more able to learn to use a VOCA than those who are hypo-reactive. Patten et al. (2013) speculate that seeking behaviours may involve more intense focus on stimuli which then impacts on attention-orienting to other stimuli, which could be more social in nature. It is therefore possible that these children learned to use their VOCAs faster than the children with a hypo-reactive pattern because their difficulty with sensory and communication difficulties are different and not related to those found in a hypo-reactive pattern (Patten et al., 2013). If this is so, they could respond differently to the AAC interventions provided. Two further children, Nathan and David, who exhibited a sensory-seeking pattern failed to achieve criterion. These two children had six allocated intervention sessions but did not receive sensory interventions as they took part in Study 1. It is possible that there would have been a different outcome had they received sensory interventions as the other participants did in Studies 2 and 3.

The group of participants in the three studies also included three children who presented with hyper-reactive patterns: Mark, Max, and Lee. Mark and Max both took five sessions to learn to use the VOCA to request, while Lee took seven sessions. This means that they learned to use the VOCA faster than the children who were hypo-reactive and took about the same time as the sensory-seekers. A

child with this pattern of sensory processing is less likely to have difficulty with communication than a child who presents with either a sensory-seeking or a hypo-reactive one (Watson et al., 2011; Patten et al., 2013). It could therefore be anticipated that they would require the fewest sessions of all children with sensory processing difficulties. It is noted that Mark was the youngest of all 12 participants, almost two years younger than some of the other participants so it is possible that due to the age difference he may have required more time to achieve the goal of requesting. Furthermore, due to illness, his attendance for sessions was inconsistent and this may have impacted on his progress leading to the need for more sessions. Lee, on the other hand, was diagnosed as predominantly hyper-reactive but fluctuated between hyper-reactive and hypo-reactive within sessions and between them. This may have had a negative impact on his learning as he was expending a lot of energy trying to maintain equilibrium leaving little energy for participation in the functional activity of communication (Suarez, 2012). It was also noted that all three children exhibited traits of over-focussing on the visuals on the display which had implications for how fast they progressed with the intervention and may have implications for choosing a symbol based system over a photo based one. Liss et al.'s (2006) research indicates that children who exhibit patterns of hyper-reactivity are more likely to over focus on visuals. The possibility that children with ASC might have more difficulty with a VSD due to over-focussing has been proposed by Wilkinson et al. (2012) although it was most evident with the children who presented with a hyper-reactive pattern in the present research. These difficulties were, however, present regardless of VSD or grid display and have implications for the kinds of visual graphic symbols utilised on the display. For Lee, it was eventually necessary to change the photos to PCS symbols and once this was implemented he progressed well. Mark also refused to touch the photo stimuli if the correspondence between the reinforcer and the visual representation was not exact e.g., colour of the ball on offer was not the same as on the display. Max touched visuals of other reinforcers to request preferred items according to the colour of the objects. According to Liss et al. (2006) children with hyper-reactivity who exhibit over-focussing are more likely

to have difficulty with social communication which may also need to be considered in the provision of AAC interventions. In particular, this may have implications for the type of graphic representation used on the visual display and symbols may be the best choice as it serves as a representation of the vocabulary.

Although this was a small group of children with ASC, the studies present some preliminary evidence that the presence of sensory processing difficulties and the type of sensory processing pattern could impact on the child's progress in learning to use a VOCA. It is, however, important to note that the presence of sensory processing difficulties does not necessarily mean that the child will have difficulty to learn to use an AAC device as a mode of communication (Ashburner et al., 2014). Understanding the individual child's sensory processing patterns is important as it may impact on the decision-making for both AAC devices and for the implementation of interventions necessary for the child to use the device in real life situations. The evidence presented above indicates that children presenting with the three sensory processing patterns: hyper-reactivity, hypo-reactivity, and sensory-seeking may progress differently within AAC interventions. From the views expressed by the OT who took part in the interview in Study 3, there appeared to be some corroboration with the children's results. In her professional expertise, the OT suggested that children with a hypo-reactive pattern were more likely to have difficulties with learning to use AAC devices and this supports the findings from Studies 1, 2 and 4. This also converges with published research which indicates that language and communication skills are most likely to be negatively impacted by children with a hypo-reactive pattern (Liss et al., 2006; Watson et al., 2011).

In proposing that different sensory processing patterns may have a differential impact on learning to use AAC devices, the question as to why sensory processing difficulties could impact on learning to use an AAC device needs to be considered. In the interview with the OT, she provided a possible explanation as she stated that when such difficulties are present, for the child, meeting sensory needs may

take precedence over other cognitive activities such as AAC device learning. This is in line with Dunn's (1997) thinking in which it is stated that when children have sensory processing difficulties, it can affect their social and cognitive development. Furthermore, it has been suggested that it is through sensory perception that the world is viewed, so ineffective sensory processing is likely to impact opportunities for learning (Caminha and Lampreia, 2012) Schaaf et al. (2011) state that the literature substantiates that sensory processing difficulties are likely to impact learning. As the theory of sensory integration proposes that learning can only take place when sensory inputs are integrated (Case-Smith and Bryan, 1999), it would appear to be a natural step to assume that this could apply to learning to use an AAC device, as to be able to use it functionally, a process of learning to use it is necessary. If this is the case, then the need to assess sensory processing and if necessary provide interventions to meet specific sensory needs should also be considered in order to achieve success with AAC interventions.

In order to accommodate sensory processing needs to support the provision of AAC interventions, the OT was of the opinion that there was a need for an assessment of sensory processing skills in the early stages of the AAC decision-making process. This, in her opinion, is useful to support understanding of the individual child and could be utilised to determine the extent and pattern of sensory processing difficulty which could impact on how the child progresses in AAC interventions. While this is the view of a single individual, this is consistent with Schaaf et al. (2014) who state that sensory interventions need to be tailored for the individual child according to their assessment results. Understanding the sensory processing of the individual child could therefore be an important part of the AAC assessment process as this information could be utilised to inform the provision of sensory processing interventions which could be carried out in tandem with AAC interventions when necessary.

In view of the above discussion, an adaptation which would take into account sensory processing patterns is proposed to the current AAC assessment process.

This is suggested specifically for children with ASC who are candidates for AAC devices. Typically, the starting point of decision-making is the initial assessment phase, as the results of assessments are used to inform interventions (Iacono et al., 2009). In Chapter 1, Beukleman and Mirenda's (2013) Participation Model (Figure 1.3) was referred to as a systematic process to guide AAC decision-making and interventions. Lund et al.'s (2017) recent exploratory study which contrasted decision-making for two children: one with physical disabilities and another with ASC suggested that different aspects of the Participation Model may require a different emphasis for children with ASC. The evidence provided in the present research also corroborates this and suggests that it is appropriate that the assessment process is guided to some extent by the characteristics of the given population. An adaptation to this model is therefore proposed based on the unique sensory processing needs of children with ASC and is supported with the evidence from the three SCED studies and the OT interview. Although the focus group specifically focussed on how clinicians provided interventions to children with ASC, the data also provided evidence which supports the need for an assessment of sensory processing. This is because assessment underlies the provision of sensory processing interventions. The proposed adaptation is the expansion of the capability profile which falls under the assessment of access barriers in the Participation Model (Figure 1.3, Chapter 1). In Figure 7.1 below, it is proposed that the capability profile be expanded to include sensory processing in addition to the areas currently included: motor, cognitive/linguistic, literacy, and sensory/perceptual. This is necessary as a pre-intervention assessment of sensory processing is recommended best practice for implementing sensory interventions (Watling and Hauer, 2015). In carrying out such an assessment, it is proposed that the AAC assessment team for children with ASC would be extended beyond the team of professionals proposed by Ganz (2014) to include the OT. The idea of including an OT on an AAC assessment team is not a new one, for example, Batorowicz and Shepherd (2011), but this is not typical for children with ASC who are being considered as candidates for AAC.

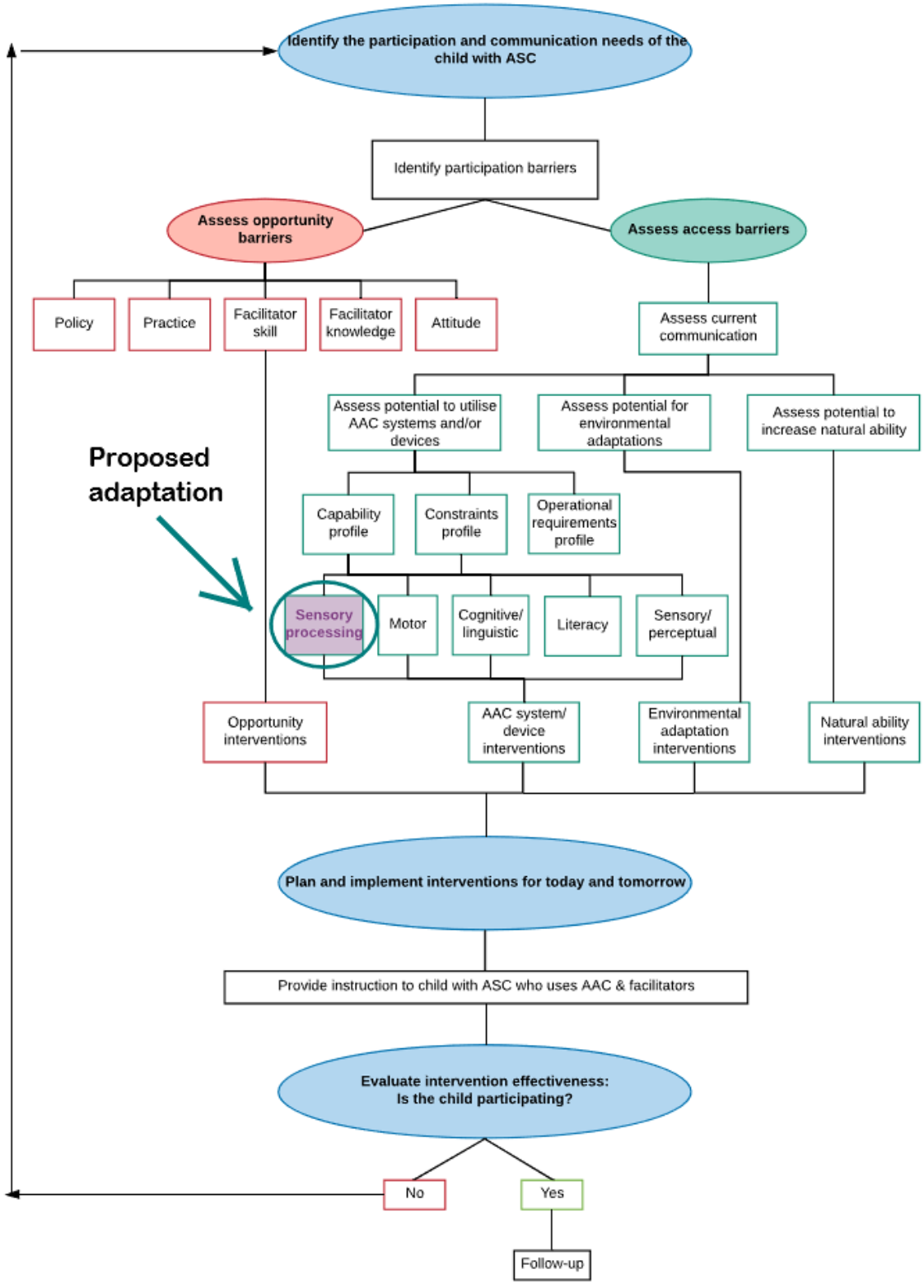

Figure 7.1 Adapted Participation model including sensory processing

To summarise this section, the results of the studies indicate that the child characteristics of children with ASC may influence how they progress in AAC interventions. This, then, has implications for the decision-making process and converges to a certain extent with the results of recent research, for example, Murray et al. (2019), who concluded that child characteristics play one part in the selection of communication aids for children who require AAC systems. The evidence in this thesis, however, provided some evidence of how child characteristics might also impact on the provision of AAC interventions thus going beyond initial AAC device recommendations. Specifically, there was initial evidence that when children present with lower levels of social-communication skills, receptive language, and adaptive functioning at the outset of interventions, a greater number of sessions of intervention may be required to achieve initial communicative goals.

There was some evidence that the presence of sensory processing difficulties was also likely to impact progress in intervention sessions. This particular child characteristic has emerged as an additional child characteristic in the present research possibly due to the participants' ASC diagnoses. It could be that this characteristic emerged in the present research and not in the Murray et al. (2019) study because in that study all the participants were AAC users who had a physical disability apart from one participant who had a diagnosis of ASC. Furthermore, it is possible that sensory processing did not emerge as a child characteristic for that particular participant as she was aged 18 years and much older than the children who were taught to use the VOCA in the present thesis. Research has indicated that sensory processing difficulties may improve as a child gets older (Leekam et al., 2007).

In order for the SLT to achieve the communication goal of requesting with this client group the research pointed to the importance of considering the individual sensory processing patterns of the child with ASC. In some circumstances this may necessitate the skills of the OT as a member of the AAC assessment team. This is

particularly important as in identifying an individual child's sensory processing needs there may be implications for how the AAC intervention is carried out by the SLT in order to achieve language and communication goals. This was particularly evident for two groups of children: those who presented with hypo-reactive patterns and those who were sensory seekers.

It is possible that the combination of sensory processing patterns and other inherent child characteristics may result in variable clinical outcomes which therefore indicates that AAC intervention has to be customised for each child on an individual level (Uljarević et al., 2017). From the results of the present research it is clear that all of these child characteristics are intertwined and it is therefore important to consider the full picture of the child's characteristics on an individual level when making decisions about AAC interventions. The research in the present thesis clearly indicates that there is great variability in learning to request despite the same diagnosis and therefore AAC interventions need to be determined on an individual basis. From a SLT perspective, then, these child characteristics should be taken into consideration when deciding the frequency and duration of AAC interventions, as well as setting communication and language goals. To a certain degree, consideration of these characteristics may support the SLT to form a prognosis of how a child is expected to progress within AAC interventions. Ways in which the AAC interventions might be individualised will be discussed in greater detail in the next section.

7.1.3 Aspects of AAC interventions

The third question which this thesis sought to answer was: What aspects of AAC interventions should be considered during the decision-making process for children with ASC? Much of the published research concerning decision-making has focused on how SLTs assess children who are minimally verbal in order to identify an AAC system which would meet their communicative needs e.g., Dietz et al. (2012), Lund et al. (2017) and more recently Lynch et al. (2019) and Murray et al. (2019). Naughton et al. (2019) note, however, that the goal of an assessment of

AAC goes beyond identifying the AAC system, it also extends to making decisions which encompass AAC strategies and techniques as well as support for stakeholders such as caregivers. Similarly, in Hamm and Mirenda's (2006) study of young adults who required AAC systems, parents expressed the opinion that receiving the AAC technology was only half of the process. They stated that the other and equally important half was the need for expertise and services for learning to use the AAC device. The identification of the AAC system itself is, therefore, the beginning of the process but consideration must be given to how to support the child to learn to use the AAC system (McNaughton et al., 2019). Deciding which intervention strategies are to be used to implement an AAC device naturally involves clinical decisions on the part of the SLT.

In this section, therefore, the possible aspects of AAC interventions which might positively influence outcomes specifically for children with ASC are considered. In doing so, assessment and intervention are therefore child-led rather than focussing solely on the technology (Light and McNaughton, 2013). Mirenda (2009) has stated that failure to learn to use an AAC device is more likely due to the way that a system has been taught rather than the choice of system. In the following section, therefore, three aspects of AAC interventions are discussed with possible implications for the decision-making process. These include: the possibility of combining sensory processing interventions with AAC interventions, the importance of bonding with the child with ASC as fundamental to AAC interventions, and the frequency of interventions.

Combining sensory processing interventions with AAC interventions

In the previous section, it was proposed that assessment of sensory processing skills should be considered as part of the AAC assessment process. To achieve this, inclusion of the OT as part of the assessment team may be considered when necessary. It may also, however, be useful for the OT to contribute to the AAC intervention process alongside the SLT in some circumstances. This is of most

relevance to situations where children with ASC present with sensory processing difficulties which impacts on their ability to learn to use an AAC device.

The results of Studies 2 and 4 in which sensory interventions were combined with AAC interventions indicated the possibility that the provision of sensory interventions facilitated the achievement of requesting with the VOCA as all eight children learned to request using at least one display layout: a VSD or a grid display. In contrast, in Study 1 Nathan and David who had sensory processing difficulties did not achieve criterion in either display. While it is acknowledged that these two children had the lowest adaptive functioning scores and social-communicative skills, as well as less sessions of intervention, it is possible that had sensory interventions been provided for Nathan and David they might have achieved criterion.

There is some support for considering sensory interventions in conjunction with other interventions to achieve functional goals. Schaaf et al. (2014), for example, suggest that when interventions are provided that facilitate sensory processing this may improve behavioural regulation resulting in improved ability to participate in social activities. Furthermore, Tomchek et al. (2015) state that sensory processing interventions should be considered as integral to interventions which promote engagement activities and this therefore has relevance to the development of communication skills of children with ASC. According to the authors, this is because sensory processing difficulties can affect the child's ability to engage in activities which may support the promotion of social communication. As described by Cafiero (2004), AAC systems and interventions, however, are also designed to promote engagement. Although the specific combination of AAC and sensory processing interventions was not found in the existing literature, the potential advantages of combining the two when necessary, should be considered as it has been suggested that sensory interventions can be implemented to support the achievement of other goals, as an adjunct to other therapies (Schaaf et al., 2014).

The combining of AAC interventions with sensory processing interventions was also favoured by the OT who took part in the interview in Study 3. Moreover, she favoured the consideration of combining the interventions from the outset. She suggested that this could be beneficial as it could result in achieving AAC goals in shorter timeframes rather than the provision of AAC interventions in isolation, thus positively impacting efficiency in terms of rate of learning and improving AAC outcomes (Schlosser, 1999a).

In order for AAC interventions to take into account sensory processing needs, as Studies 2 and 4 did, it was necessary for the SLT and OT to work together in providing AAC interventions in combination with sensory interventions. While the goal of improving communication is traditionally within the realm of the SLT, Schaaf and Miller (2005) state that OTs may utilise sensory based approaches to support children to learn and interact with others and thus there does appear to be common ground between the goals of the two professions. Tomchek et al. (2015) specifically state that there could be value in greater collaboration between SLTs and OTs in terms of more positive outcomes in the area of language. The concept of both of these professionals working together within the field of AAC is not a new one and teamwork has been highlighted as a model of best practice (Beukelman and Mirenda, 2013). It has also been suggested that collaboration between different professionals can facilitate decision-making (Batorowicz and Shepherd, 2011).

The focus group data highlighted the communication between the two therapists involved in implementing the interventions in Study 4. There was particular reference to how the clinicians discussed and made decisions in the moment for individual children. This was reflective of a transdisciplinary model, one in which there is close collaboration between team members to the extent that the boundaries of the two disciplines may partially disappear so that the specialised roles carried out by each discipline complements and even replaces each other when needed (Thylefors et al., 2005). It might be useful to consider this kind of

working for children with ASC as it may improve the quality of service for children with ASC who are minimally-verbal especially when sensory processing difficulties are present.

There are some elements of providing sensory interventions which would require decision-making to be made by both professionals: SLT and OT, should such interventions be utilised in combination with AAC interventions. This includes decisions concerning the kind of sensory interventions required: environmental accommodations and/or sensory processing interventions, where these interventions might be implemented, and whether both professionals are required for the intervention plan to be implemented. Such decisions would be based on the outcomes of assessments carried out in the assessment phase. A proposed decision tree for deciding which professionals could be involved in AAC interventions for children with ASC is presented in Figure 7.2.

For minimally verbal children who have a diagnosis of ASC but do not present with sensory processing difficulties an OT is generally not required and AAC interventions would be provided in the usual settings e.g., a speech and language therapy clinic, educational setting, home.

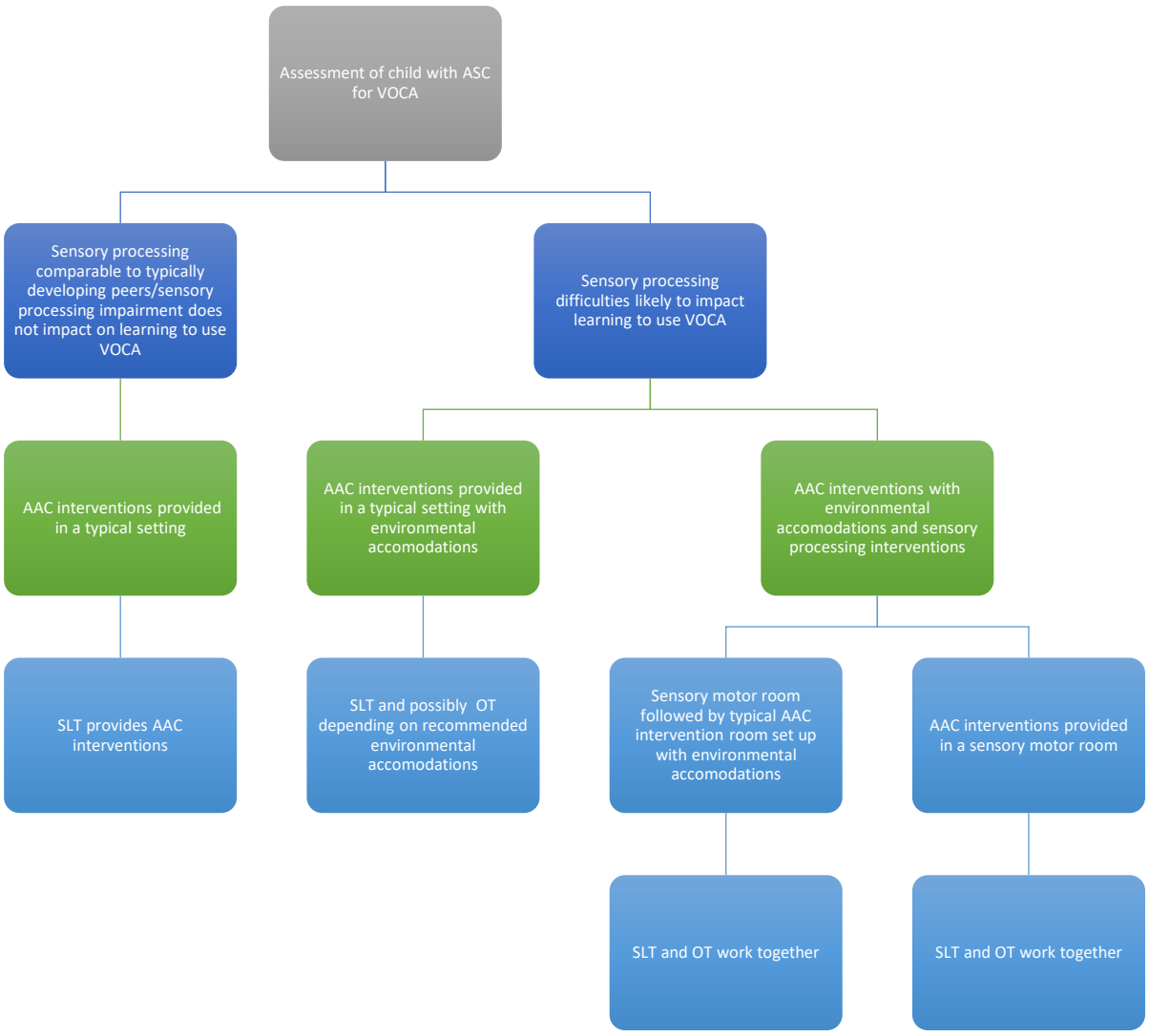

Figure 7.2 Proposed decision-making tree for providing AAC interventions to children with ASC

When sensory processing difficulties are evident that are likely to impact learning to use a VOCA, it is possible that environmental accommodations e.g., positioning of furniture to create boundaries would be sufficient to support implementation of AAC interventions. In such scenarios a SLT may be able to implement these independently. This is, however, dependent on the kind of environmental accommodations recommended by the OT. In the studies presented in this thesis, environmental accommodations as the main sensory intervention strategy were most often recommended for children with a hyper-reactive pattern. In other scenarios, for example, with children who presented with a hypo-reactive or

sensory-seeking pattern, sensory interventions consisted of a combination of intervention approaches and therefore sensory processing interventions were also provided in a sensory motor room. Although only 12 children participated across the three studies, for children whose level of arousal was low and were therefore hypo-reactive, access to the sensory motor room was necessary to provide them with the required sensory input to support their sensory regulation. This was needed as children who are hypo-reactive tend to be passive, inattentive and under-reactive (Ashburner et al., 2014). For children such as these, therefore, environmental accommodations may need to be provided in combination with other sensory interventions which may take place in a specialised sensory motor room. In such instances, the interventions must include the OT who has the training and knowledge of how to use such equipment. In Studies 2 and 4, when children accessed sensory processing interventions in a sensory room this was always done prior to interventions targeting AAC. This was to ensure that results could be attributed to the AAC intervention and to maintain consistency in the implementation of procedures across Studies 1, 2 and 4. The OT interviewed in Study 3 suggested, however, that it might be possible to implement the AAC interventions in tandem with the sensory processing interventions in a sensory motor room as another option. In such a scenario, the two interventions would truly be integrated and both professionals, SLT and OT would be required.

The importance of connecting with the child with ASC as fundamental to AAC interventions

There is evidence from Studies 3 and 4 which presents another area of AAC interventions for consideration: the influence of the clinician as the human component in the provision of AAC interventions. Within the speech and language therapy literature, it has been hypothesised that the human factor is particularly influential in the success of interventions and should not be disregarded (Bernstein Ratner, 2006; Ebert and Kohnert, 2010).

With children, it is has been suggested that the establishment of the child-clinician bond, also referred to as a therapeutic alliance, is particularly important as failure to establish this can lead to poor intervention outcomes (Fourie et al., 2011). Specifically, the ability to bond with the child with ASC may be significant as research has indicated that clinicians are an important factor in treatment outcomes and may even influence the outcomes independent of the actual intervention itself (Ebert and Kohnert, 2010). The importance of bonding between the clinician and child within the therapeutic process has previously been described in the literature pertaining to speech and language therapy e.g., Ebert (2018) who concluded that parents placed particular value on the emotional bond between child and clinician. Perhaps, for this thesis, it is the children's diagnosis of ASC which makes the issue of bonding particularly relevant as this diagnosis is strongly associated with difficulties with social communication (American Psychiatric Association, 2013). It is the difficulties in the area of social interest which sets this group of children apart from other children who are minimally verbal yet instinctively have a knowledge of how to communicate (Ganz, 2015). The consequences of these difficulties include an impact on the child's ability to initiate communication with adults as well as less frequent and poorer quality interactions with communication partners (Chiang et al., 2008; Kuo et al., 2013). In some instances, the child with ASC may have limited interest in others (Centres for Disease Control and Prevention, 2018). Consequently there is an onus on the clinician to find ways to bond and communicate successfully with the child and this theme was also identified in the focus group data from Study 4. To further compound the communication issues associated with ASC, the presence of sensory processing difficulties are also more likely to impact on the child's ability to engage with others or within activities (Tomchek and Dunn, 2007). If this is the case, the clinician's ability to form bonds might be further impacted and this may have consequences for teaching AAC device use.

In Study 4, the focus group data indicated that during the observed intervention sessions the clinicians varied their communication according to different children

although the clinicians remained within the study protocols. The data, albeit limited, provided some preliminary evidence that this may have been done to match the child's sensory processing patterns which in turn could foster bonding with the child e.g., research has demonstrated that children who present with a hypo-reactive pattern are likely to be less responsive to adult and peer attempts at social engagement (Williams et al., 2018). For these children, the clinician's communication, which was generally described as alerting in terms of the use of a higher pitch and an exciting tone of voice may have been used to support the child to respond. Furthermore, clinicians used more animated facial expressions and made use of touch: features of communication which could be more likely to support the child to attend to sensory input from the environment. Conversely with children who presented as hyper-reactive, communication was calming with more neutral use of facial expressions which may have supported the child to attend to the clinician.

While no published research was found in the field of AAC which directly refers to the use of communication skills to which these results can be related, the OT literature does refer to the 'conscious use of self' which was first described by Mosey (1981). The use of self refers to the clinician's ability to respond to clients in a thoughtful and planned way. This involves the deliberate use of communication and therefore requires responding differently to individual clients (Solman and Clouston, 2016). Taylor (2008) discusses how the use of self can be utilised to promote engagement and therefore more positive therapeutic outcomes. Furthermore, the use of the self is central to the provision of sensory processing interventions in which the clinician works to develop rapport with the child, reading the child's cues through the child's nonverbal communication (Schaaf and Mailloux, 2015). It is possible that the OT, who has the knowledge of the use of self, was consciously practising it during the interventions observed by the focus group participants. On the other hand, the researcher (who was the SLT) may have been mirroring the OT or may have had knowledge of how to adapt herself to the children's communication and sensory processing pattern

through previous clinical experience. This could be possible as the researcher had extensive past clinical experience of working to implement AAC systems with children with ASC.

As the use of the self is an intentional process there are some implications which can be considered when implementing AAC interventions for children with ASC and sensory processing difficulties. Clinicians involved in providing AAC interventions to such children may need to consider how they communicate within their sessions, in order to support engagement and rapport. Furthermore, this should take into account the child's sensory processing pattern as suggested above. Very clearly, given the nature of communication difficulties experienced by this group of children, it is the clinician's role to adapt to the child to support interaction and engagement as a foundation for teaching AAC use.

The success of the implementation of AAC devices can be attributed in part to the commitment of parents and other communication partners (Parette and Angelo, 1996; Blackstone et al., 2007). Parents and other communication partners, require support and training to be responsive communication partners in situations where the child requires AAC (Starble et al., 2005; Binger et al., 2008; Binger et al., 2010). The clinician who is implementing AAC interventions has a role to train family members and other communication partners to respond to the communication of the child who is learning to use a VOCA (Romski and Sevcik, 2005; Light and McNaughton, 2013). The question here is what happens if the child's sensory processing difficulties impact the adult's ability to bond with the child? Watson (1998) describes children with ASC who are extremely active or who focus on one toy. In their observational study mothers utilised more child directed utterances that were out of focus for the child which is suggested may have a possible impact on the relationship between the adult and child. Out of focus utterances were defined as those which were relevant to the immediate context but not to the child's focus of attention and the authors speculate that the increased use of such utterances may have been in order to try to establish and

maintain joint attention. Difficulties with joint attention have been hypothesised to be linked to sensory processing difficulties e.g., Liss et al. (2006). Similarly, child behaviours of over activity or over focussing on one object were also observed in the children who took part in Studies 1, 2 and 4. Communication partners need to be able to bond with the child in order to implement AAC interventions and it could be helpful to understand how the child processes sensory information in order to do this. This kind of knowledge and skill can also be related to the opportunity barriers which are described in the Participation Model (Figure 1.3). Of most relevance here, are the two areas: knowledge and skill barriers which are both part of the opportunity barriers.

In a recent systematic review of the moderators, predictors, mediators of AAC outcomes, Sievers et al. (2018) classified the communication partner as a mediator. Mediators were defined as factors that are assessed during the implementation of intervention and are associated with outcomes. For children with ASC and sensory processing difficulties, communication partner knowledge of the AAC device and intervention strategies used to implement this may not be adequate to achieve the desired outcomes with the AAC device. The present research indicates that further knowledge of how the child with ASC processes sensory information and how this impacts on learning to use an AAC device may also be necessary. Another area of skill, according to Beukelman and Mirenda (2013), refers to the skills which are necessary to support a child to become a competent communicator. This can be extended to include the adult's capacity to match communication to the child's sensory processing pattern as a foundation for supporting AAC device use. Further proposed adaptations to the Beukelman and Mirenda's (2013) Participation Model which incorporate a more definite link between the facilitator's skill and knowledge and the child's sensory processing are therefore proposed in Figure 7.3.

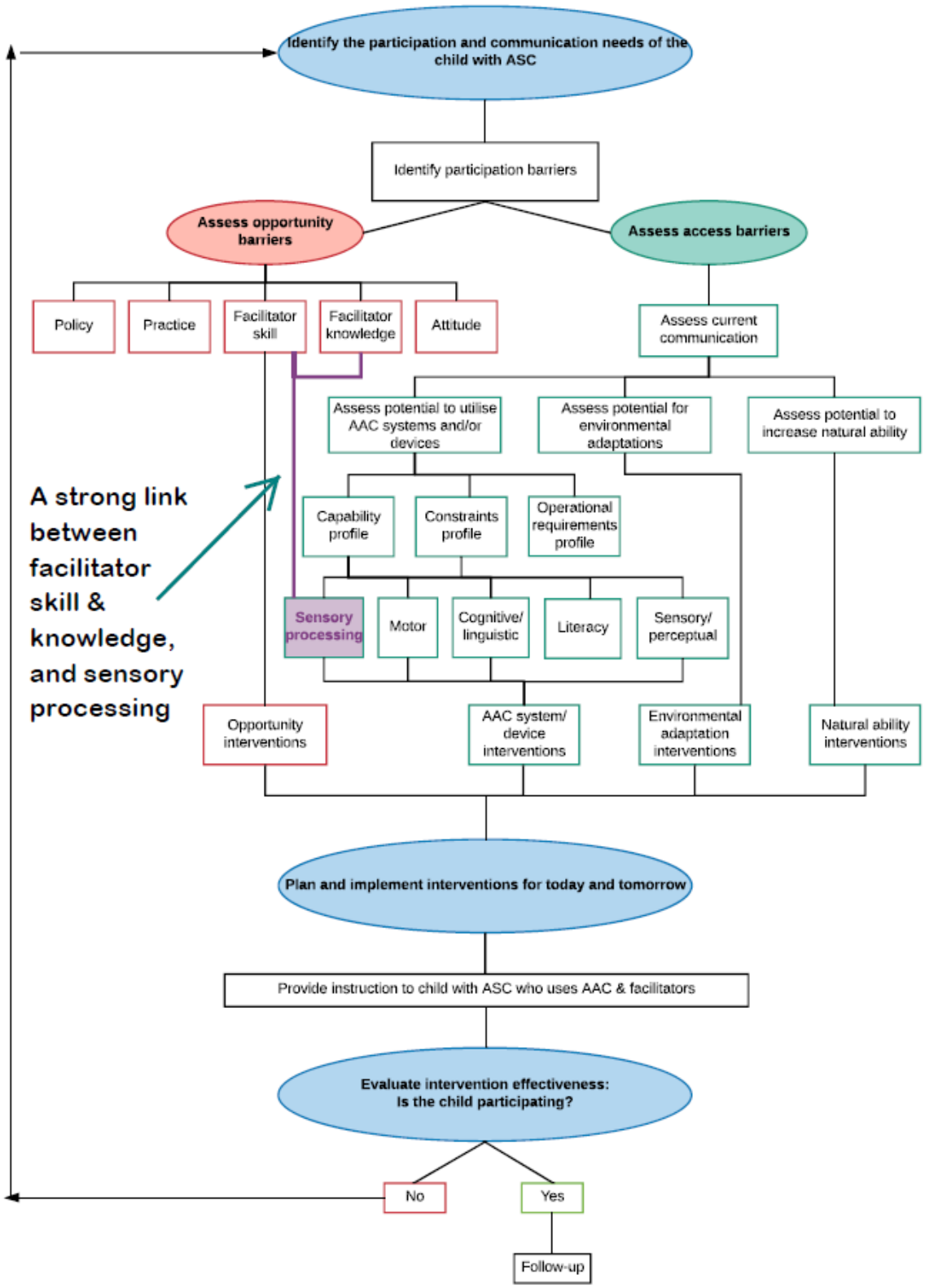

Figure 7.3 Proposed Participation Model incorporating changes to opportunity barriers

Frequency of interventions

The sections above refer to the settings and interventions within which the clinician needs to make decisions about how to support children with ASC to learn to use AAC devices. The possibility of adapting communication to enhance the therapeutic process was also discussed, e.g., where, when, and by whom. A further clinical decision which could be considered is the number of intervention sessions which would be provided before deciding to make a change to the intervention. In Studies 1, 2 and 4, the number of sessions which children required to achieve criterion appeared to be linked to a certain extent to child characteristics, for example, those children who presented with lower adaptive functioning levels required a greater number of sessions. The kind of sensory processing pattern the child presented with also appeared to be a factor in the number of sessions required. Clinicians may need to adjust their expectations of how the child will progress in accordance with the sensory processing pattern as it appeared from these studies that children with hypo-reactive and sensory-seeking patterns required a greater number of sessions. In some instances, it may appear that these children are not progressing or are making minimal progress, but with an increased allocation of sessions it might be possible that they would achieve desired goals in terms of VOCA use thus the clinician needs to be persistent in implementing interventions. This is particularly relevant for children with hypo-reactive patterns who may not achieve any correct responses in their first sessions.

Clinical decisions may also need to be taken in relation to frequency of sessions although this was not directly explored in the implemented studies. All children received between two and three sessions a week unless they missed sessions due to illness. This is a relatively high dosage compared to what is often possible in typical SLT clinics. Questions remain as to whether the results would have been similar had sessions been spaced further apart. Both Max and Zak missed a number of sessions and it is possible that had they attended for sessions as originally planned they might have achieved criterion faster. Ganz et al. (2010)

suggest that for PECS training, more or less intensive intervention may impact on children's progress and it is possible that this could also be relevant to the implementation of high tech AAC modes. It is possible that for some children, particularly those presenting with a hypo-reactive pattern, that sessions are required on a more frequent basis due to their low arousal levels which affects their ability to register sensations (Suarez, 2012).

7.2 Clinical implications

The main aim of this research was to advance the current framework utilised for the decision-making process for AAC interventions for children who have ASC. In doing so, it was hoped that this research would lead to recommendations which would lead to improved outcomes of AAC interventions for children with ASC.

The main implication of the results presented for this thesis is the need for AAC interventions to be individualised to each child with ASC. These can be individualised in different ways: according to the child's characteristics, in terms of the AAC device itself, and in relation to how the interventions are actually implemented. Each of these is discussed individually below, although it is acknowledged that it is a complex interplay between all of these which must be taken into account when deciding how best to support a child with ASC to learn to use an AAC device.

Child characteristics

The findings of the research presented in this thesis clearly indicate that it is not possible to base clinical decisions on one child characteristic and this is similar to Murray et al.'s (2019) findings. ASC is particularly complex and includes cognitive, language, sensory processing as well as social and emotional issues (Ashburner et al., 2014). In making decisions, therefore, the clinician should take a holistic view, considering how adaptive functioning, existing comprehension, early communication skills, and sensory processing abilities influence each other and how that combination might impact learning to use an AAC device.

Although it is acknowledged that further research into how child characteristics impact learning to use AAC devices is needed, some trends emerged within the 12 participants' results that could have implications for the SLT. This is important for intervention planning as for some children the process of learning to use the AAC device takes longer than for others. In view of this, SLTs should consider that the presence of lower levels of adaptive functioning and early social communication skills are likely to impact on a child's progress within AAC interventions, requiring a greater number of sessions and possibly slow progress in the initial stages.

In the research presented in this thesis, sensory processing abilities were heavily emphasized. This was because the consideration of sensory processing is new to the field of AAC. Sensory processing, however, is intricately related to other child characteristics including existing communication, adaptive functioning, and comprehension and is therefore just one piece of the puzzle (Ashburner et al., 2014). As research, for example, Ben-Sasson et al. (2009) has indicated that a large percentage of children with ASC have sensory processing difficulties, which as this research suggest could impact on learning to use an AAC device, it is recommended that the child is assessed for sensory processing difficulties at the outset. This may mean that the OT is included in the AAC assessment team for children with ASC. Understanding the extent and nature of sensory processing difficulties enables the SLT in collaboration with the OT to decide on which AAC intervention strategies to use going forward and how these might be implemented.

The data presented in this thesis indicates that the SLT should consider the sensory processing pattern that the child presents with. Hypo-reactive and sensory-seeking patterns are more likely to present a challenge to the SLT which would require specific OT support and possibly an increased number of sessions planned from the outset due to anticipated slower progress. Furthermore, some children may present with sensory processing difficulties, but the SLT may be able to support sensory integration without the need for an OT to be present in the

interventions e.g., by implementing OT recommended strategies to support sensory integration within AAC interventions. Some children with ASC may present with sensory processing difficulties but this may not impact their ability to learn to use a VOCA, in which case OT input would not be required, although this was not evident in any of the participants who were recruited for this research.

AAC device

The research presented in this thesis indicates that the AAC device display did not appear to be an important factor in how the children progressed in learning to use the VOCA to request. In the present research, the children learned to request within a similar number of sessions with both the VSD and the grid display. SLTs should therefore take into account how the AAC device might support the child to construct novel utterances in the longer term as this is the ultimate goal (Abbott and McBride, 2014). Given the diagnosis of ASC, it would not be useful to teach a child to use a device for a short time and then transfer to another due to limitations of the vocabulary software as this would result in having to teach a new device again.

A further consideration for SLTs, although not implicitly discussed in this PhD, is the choice of AAC device: low tech versus high tech communication device. Even though not all 12 children achieved criterion, all of them learned to request on some level using the high tech AAC device. For Nathan and David who did not, there was also a history of difficulty learning to use the low tech AAC device or they were still in early stages of learning to use the Picture Exchange Communication System (PECS). In view of this, these three studies add to the existing literature e.g., Agius and Vance (2016) which have demonstrated that children with ASC who are beginning communicators can be equally taught to use low tech and high tech AAC systems from the outset.

Implementation of AAC interventions

In terms of how AAC interventions are actually implemented, a number of implications for clinical practice are evident. Firstly, the importance of the SLT as the implementer of interventions emerged strongly. The AAC system should be considered as one component of the AAC package, and the SLT's ability to implement AAC interventions another (Iacono et al., 2016). Perhaps, because AAC is a relatively young field there has been a strong focus on matching the AAC system to the child e.g., Gosnell et al. (2011) but the present research clearly indicates that the skill and knowledge of the SLT are important to achieve positive outcomes. For a child with ASC, understanding of child characteristics inclusive of how the individual child processes sensory information is important for goal setting (Smith and Iadarola, 2015). This knowledge is also important to be able to forge connections and bond with the child as an important component of the intervention process. The preliminary evidence from this research suggests that the child's sensory processing pattern may play a part in how SLTs communicate with the child with ASC and this is integral to the bonding process. Furthermore, it is suggested that apart from being mindful of how we, as SLTs, can bond with the child, the SLT needs to be aware of the importance of supporting other communicative partners to do this as well. This is in keeping with existing AAC literature which makes reference to the importance of communication partners in supporting the learning of AAC devices with individuals who are beginning communicators e.g., Higginbotham et al. (2007) and Light and McNaughton (2015). Furthermore, being aware of the need to support communication partners addresses any potential knowledge and skill barriers which might be present at home or at school (Beukelman and Mirenda, 2013).

With reference to the SLT's skill and knowledge, knowledge of both behaviourist and naturalistic techniques are required for the teaching of the VOCA (Van der Meer and Rispoli, 2010). This includes clinical knowledge of the behaviourist techniques of prompting and fading as well as naturalistic techniques such as knowing how to provide incidental teaching opportunities, following the child's

lead, and environmental arrangement are all required. Understanding how to choose the right combination of strategies, in the moment, is a measure of the clinician's flexibility in terms of knowledge and skills, and should be considered in the provision of AAC interventions. Furthermore, this is influenced to a certain extent by the child's individual characteristics (Gevarter et al., 2013a). In view of this, it is necessary for SLTs to consider how parents will be involved in the interventions as it has been suggested that there could be difficulties with generalisation once the intervention has been carried out by skilled SLTs and needs to be transferred to the home situation (Iacono et al., 2016). One option could be to implement the interventions with parents being coached in tandem. For other parents it might be more useful for them to become more fully involved subsequent to the child achieving predefined communication goals. This might be necessary in situations when parents have experienced failure in implementing the use of AAC devices with their children in the past.

7.3 Strengths and Limitations

As with any research, there were some limitations to the studies presented in this thesis that must be considered when interpreting the findings. The limitations of the studies will be discussed in turn by type of research: firstly quantitative and then qualitative studies. Strengths of this research will then be discussed in the following section.

7.3.1 Quantitative study limitations

As all the (Studies 1, 2 and 4) SCEDs were of similar design, the limitations of the intervention component will be discussed together. One important question that could be asked is whether the results of these studies are applicable to other children with ASC who may or may not have additional sensory processing difficulties. It is necessary to ask this question as a small number of participants who were all boys took part in each of these studies, In general, external validity (or generalisation) of the findings is established by systematic replication (Sidman, 1960). In this research, the study was implemented on three occasions with 12

children so some replication was evident. Further research in which additional participants are involved is still necessary to determine whether similar results would be achieved with other children with ASC and sensory processing difficulties.

Another limitation also related to the issue of generalisation was that data was not collected in different contexts, with different people, or in relation to other communicative functions such as commenting or negating. It is therefore unknown if the requesting skills taught by clinicians in clinical settings would have generalised to other settings such as at home or in school. Furthermore, it is not known if the children would have generalised to requesting from other communicative partners such as parents or teachers. The issue of generalisation to different settings and partners is particularly relevant to children with ASC as they have particular difficulty in generalising skills (Ganz, 2015). Two participants, however, spontaneously requested reinforcers from their parents during the study. The study was also limited to teaching one communicative function; the skill of requesting. This is the case in many research studies which teach AAC use to beginning communicators and is recommended in the early stages of AAC interventions (Ganz et al., 2012b). Due to time limitations it was not possible to teach other communicative functions although it is possible that further differences between the two display layouts which were compared in Studies 1 and 2 would have revealed themselves had this been targeted.

Assessment of child characteristics was carried out using a range of assessments. The Vineland-2 (Sparrow et al., 2005) provided a measure of receptive language age equivalence through parental report. It is felt, however, that assessment of receptive language skills using a clinician administered assessment such as the Preschool Language Scale-5 (Zimmerman et al., 2011) might have provided a more accurate picture of comprehension skills as it would have been administered by a SLT with the appropriate training. In doing so, the possibility of parental bias which might have inflated or underestimated the child's true level of

comprehension would have been minimised thus ensuring greater consistency across the participants' comprehension results. Furthermore, an assessment test designed specifically to assess for comprehension of language is likely to be more finely tuned and might therefore reveal trends of how existing comprehension levels impact learning to use AAC devices.

Another limitation concerns the provision of sensory interventions in Studies 2 and 4. Firstly, the main goal of the three SCEDs was to teach the participants to request using the VOCA. In Studies 2 and 4, however, sensory interventions were included as all participants had a diagnosis of sensory processing difficulty. As the interventions were provided during all phases of these studies it is not known how each participant would have progressed without the sensory interventions. In Study 1, however, two participants who had sensory processing difficulties did not achieve criterion while all participants achieved criterion in at least one display in the subsequent studies. Although this may have been due to the increased number of intervention sessions in Study 2, it is also possible that this was due to the provision of sensory processing interventions which were only provided in Studies 2 and 4. Furthermore, Andy, who took part in Study 2 had a period of AAC intervention in which sensory processing interventions in the sensory motor room were not provided. His results indicated that he did not continue to make the same progress in learning to use his AAC device without the sensory processing interventions. A further limitation linked to the introduction of sensory interventions is that although goals were set for sensory processing, changes in the participants' sensory processing were not reassessed. This was due, in part, to the use of the Short Sensory Profile (McIntosh et al., 1999) as the assessment instrument. This particular assessment is not designed for short term pre post assessments and therefore the participants' progress in terms of their sensory processing could not be reassessed (Schaaf et al., 2014). Importantly, however, it has been suggested that a measurement of treatment outcomes for sensory processing could be utilised e.g., Goal Attainment Setting (GAS) which has been

cited in the sensory processing literature as a means of identifying intervention outcomes specifically relevant to the child and family (Mailloux et al., 2007).

It could be suggested that one limitation of the SCEDs was that the interventions were implemented by clinicians while parents were only in attendance as observers for the sessions. While it is acknowledged that parent implemented interventions are important as children are likely to spend large amounts of time with their parents (Kent-Walsh and McNaughton, 2005), the children who participated in the study were children who presented with a range of challenges related to their diagnosis of ASC. In addition, ten of the children presented with additional sensory processing difficulties which required experienced clinicians who were able to draw on knowledge and experience in the moment.

A further limitation of the quantitative studies was that some of the participants e.g., Jake in Study 1 and James in Study 4 both of whom had achieved Phase III of PECS, had some prior experience of AAC use. It is possible that this might have influenced their progress in the study. None of the participants, however, had any experience of using a VOCA for communicative purposes. It would have presented significant challenges to recruit only participants who had never used AAC previously as the majority of referrals from which the participants were recruited were referred by community SLTs who would have tried to implement AAC interventions including low tech AAC systems such as PECS prior to referral.

A final limitation was that although the same intervention procedure was used for all participants, attendance was slightly different as some participants, in particular Andy, Zak, and Mark in Study 2 missed a number of sessions. The missed number of sessions might have led to a greater number of sessions to reach criterion as their attendance was not regular.

7.3.2 Qualitative study limitations

One of the limitations of the qualitative study, Study 3, was in the recruitment procedure. It was necessary to recruit an OT who was involved in the provision of AAC interventions and therefore a purposive sampling procedure was utilised. As the OT who participated in this study was the same OT who supported the implementation of interventions in Studies 1 and 2 it is possible that her opinions were to a certain extent influenced by the researcher and author of this thesis who also involved in the design and implementation of these studies. Every effort was made to minimise this e.g., the results of each participant were not discussed with the OT but as a clinician involved in the implementation of the intervention her awareness of the progress each participant made could not be eradicated. Furthermore, given the fact that it was one OT who was interviewed it is possible that other OTs may or may not agree with her opinions. While it could be said that this would limit generalisation of the results, the purpose of this study and of qualitative research in general is not to generalise results (Smith, 2018), but to generate rich knowledge and insight into this particular OT's opinions as a clinician involved in AAC interventions for children with ASC. It is also possible, on the other hand, that this OT's opinions may resonate with other clinicians and in this case the notion of 'representational transferability' could apply (Lewis et al., 2013). Furthermore, the themes identified in this study would need to be validated possibly through replication of the study with a greater number of participants.

For the focus group, which was carried out as part of Study 4, the main limitation was the limited clinical experience of the participants which was under 2 years for each of them. Although participation in the focus group was offered to more experienced clinicians, they declined to take part in the study. It is possible that had they taken part, other themes would have been identified in the data. A further limitation lies in the relationship between the researcher and the participants who took part in the focus group as the researcher was more senior to them in the everyday work scenario. The researcher's presence as assistant

moderator during the focus group meeting may have therefore inadvertently influenced the discussion.

The focus group was used primarily as a preliminary exploration of how clinicians communicated with the children during the provision of the AAC interventions. This, however, resulted in data related to communication being meshed with the intervention strategies themselves which was not the original goal of the study but was useful in terms of providing other insights into how clinicians provide AAC interventions to children with ASC and sensory processing difficulties.

7.3.3 Strengths

In spite of the limitations described above, the research presented in this thesis has a number of strengths. Firstly, the research describes three intervention studies which contributes to external evidence and can therefore be used to inform evidence based practices (Dollaghan, 2007). The studies presented are valuable as intervention studies within the field of AAC are few (Smith and Hemsley, 2018). Despite the challenges of designing and implementing intervention studies, these studies were carried out in real clinical contexts and therefore involved real world research which could therefore be carried out by clinicians in typical clinical settings.

The four research studies have provided data which covers a range of topics within the field of AAC including child characteristics, partner variables and AAC device features all of which are relevant to the field (Kent-Walsh and Binger, 2018). Furthermore, the research brings all three of these together as important for decision-making rather than relying on one area for the success of implemented AAC interventions (Lynch et al., 2019; Murray et al., 2019).

A further strength of this PhD research was the use of mixed methods to answer the overarching research question. This research included both descriptive (interview and focus group) and experimental (SCED) designs. The use of

qualitative designs allowed the researcher to explore new and under-researched areas (Kent-Walsh and Binger, 2018). This included the impact of sensory processing difficulty on learning to use AAC, and the importance of bonding and communicating with the child during interventions. Furthermore, the inclusion of social validity in the SCED designs allowed the parents the possibility of expressing their own opinions of the interventions carried out with their children thus ensuring that the features of the AAC device and the interventions used were truly consumer-oriented (Light and Drager, 2007). This is important as interventions which are considered to be socially valid are more likely to be adopted by caregivers (Schlosser, 1999b).

In this research, the AAC interventions were planned by the researcher who was a SLT and implemented by the researcher with the support of an OT. In the focus group, both SLTs and an OT were participants. The inclusion of OTs within this research has added an interesting dimension to this research making it cross disciplinary and collaborative and this could be viewed as a strength as in combining information from both disciplines it was possible to gain a different perspective of AAC interventions for children with ASC. From this it was possible to generate new theories of what is likely to work well in future AAC interventions for children with ASC.

7.4 Future research directions

Given the discussion above, it is possible to make some suggestions for future research. Although 12 participants with ASC were taught to request, the study design could be systematically replicated with other participants with ASC. In doing so, further information could be gained on how participant characteristics might impact learning to use a VOCA. The inclusion of formal assessment to assess comprehension may shed further light on how existing comprehension skills impact this process as it was felt that the receptive language skill section in the Vineland-2 (Sparrow et al., 2005) provided the researcher with limited information. This is important as there continues to be a need to understand how

child characteristics may influence progress in AAC interventions (Iacono et al., 2016). This is likely to impact on the decision-making process in terms of the clinician's expectations and the frequency of sessions provided.

Refinements could be made to the design of the study to include generalisation to different contexts such as home and school and with different communicative partners as the skill of communication is used in all settings (Light, 1997). Furthermore, future research could focus on teaching more complex communication as much of the published research in AAC device acquisition has focussed on requesting (Gevarter et al., 2013b; Ganz, 2015). This could include commenting, answering questions, and greetings. In Study 4, the VSD was not included as the evidence from Studies 1 and 2 combined with parental and OT opinion was not sufficient for its continued use in Study 4. Technology, however, in the field of AAC continues to move forward e.g., Light et al. (2019b) suggest that the more recent development of use of motion within VSDs may serve to positively attract and maintain attention. In Light et al.'s (2019b) review of AAC display designs, it is suggested that the use of video integrated in a VSD can serve to capture the more dynamic aspects of an interaction which can then be used to provide communication supports at specific stages within the video. It is possible that this might be useful for teaching individuals with ASC some elements of communication: for example, a recent paper by Babb et al. (2018) describes how a teenager with ASC was successfully taught to communicate specific communication acts within the context of a library setting using video integrated in a VSD. Future research would be required to determine if the proposed advantages of motion within VSDs could be extended to preschoolers with ASC.

A further direction for future research concerns the impact of sensory processing difficulties when these co-occur with ASC on learning to use a VOCA. The present research documents the first studies which specifically implemented intervention which combined sensory processing interventions with AAC intervention. As described in the limitations above, it is unclear how the children in Studies 2 and 4

would have progressed without the sensory processing interventions although a glimpse was provided by one child who stopped receiving the sensory processing interventions in the sensory motor room due to an injury. Furthermore, the two children who did not achieve criterion in Study 1 did not receive sensory processing interventions but presented with difficulties which likely did impact on their ability to learn to use the VOCA. Combining an understanding of how the children in these studies progressed with knowledge of the theory of sensory integration suggests that sensory processing difficulties need to be addressed for children to make progress in AAC interventions. If not, it is possible that interventions would take longer to implement or goals set may not be achieved. In view of this, future research which compares interventions with and without sensory processing interventions is recommended. It is also necessary to carry out further research which explores how the different sensory processing patterns impact learning to use a VOCA.

Linked to the use of sensory processing interventions as an adjunct to AAC interventions is the opinion of the professionals who generally assess and make decisions regarding their use. In this study, the opinions of one OT who was involved in the implementation of the interventions were solicited. Future research which involves more participants within the OT profession working both in Malta and internationally would add to the current research findings. It is possible that their opinions might present other directions for consideration when designing AAC interventions for children with ASC and sensory processing difficulties.

A final possibility for future research is the necessity to research further how SLTs can bond with children with ASC as an important foundation for successful AAC interventions. More objective measures of how clinicians communicate during the provision of interventions could also be included e.g., video recording which would be analysed and cross referenced to child characteristics.

7.5 Conclusions

This thesis aimed to explore and provide insights into decision-making to improve outcomes for minimally verbal children with a diagnosis of ASC who require AAC devices to support their expressive communication. In order to achieve this a mixed methods approach was taken which included the use of a SCED, an interview, and a focus group. Taken together, the results suggest that decision-making for AAC devices and interventions for this client group must be multifactorial. While it is acknowledged that matching the technology to the child is an important part of the process, the results did not indicate any specific benefit of the use of a grid display versus a VSD for the organisation of vocabulary when teaching requesting to children with ASC. The results do suggest, however, that child characteristics play an important part in how children with ASC progress in AAC interventions and therefore decision-making should take these characteristics into account. In particular, the need to consider the sensory processing patterns of the child during the assessment and intervention process was highlighted and is a new contribution to the field of AAC. The results indicated that for some children with ASC it is useful to consider combining AAC interventions with sensory interventions in order to support learning. Furthermore, the results suggested that successful AAC interventions with this client group are founded on strong clinician child bonds which are influenced by the child's sensory processing patterns and the communication skills of the clinician. Given the results of the series of four studies, further research is required to determine how the sensory processing patterns of children impact the decision-making process with AAC interventions.

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An exploration of factors to improve outcomes in the area of AAC interventions for children with ASC

May Agius

A thesis submitted for fulfilment of the requirements of the Manchester Metropolitan University for the degree of Doctor of Philosophy

Department of Health Professions

2019

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Appendix 1

Ethics approvals and permissions

Ethics approval for Studies 1 and 2: Manchester Metropolitan University

MANCHESTER METROPOLITAN UNIVERSITY
FACULTY OF HEALTH, PSYCHOLOGY AND SOCIAL CARE

M E M O R A N D U M

FACULTY ACADEMIC ETHICS COMMITTEE

Manchester Metropolitan University

To: May Agius

From: Prof Carol Haigh

Date: 23/06/2015

Subject: Ethics Application 1285

Title: Clinical decision making for children with autism spectrum disorder who require augmentative and alternative communication

---

Thank you for your application for ethical approval.

The Faculty Academic Ethics Committee review process has recommended approval of your ethics application. This approval is granted for 42 months for full-time students or staff and 60 months for part-time students. Extensions to the approval period can be requested.

If your research changes you might need to seek ethical approval for the amendments. Please request an amendment form.

We wish you every success with your project.

Prof Carol Haigh and Prof Jois Stansfield
Chair and Deputy Chair
Faculty Academic Ethics Committee

Ethics approval for Study 3: Manchester Metropolitan University

Manchester Metropolitan University

M E M O R A N D U M

FACULTY ACADEMIC ETHICS COMMITTEE

Faculty of Health, Psychology & Social Care

Brooks Building
Birley Fields Campus
53 Bonsall Street
Manchester
M15 6GX

+44 (0)161 247 2569

HPSCresearchdegrees@mmu.ac.uk

To: May Agius

From: Prof Carol Haigh

Date: 23/08/2017

Subject: Ethics Application 1285

Title: Clinical decision making for children with autism spectrum disorder who require augmentative and alternative communication

---

Thank you for your application for an amendment to your original ethical approval.

The Faculty Academic Ethics Committee review process has recommended approval of your amendment. This approval is granted for 42 months for full-time students or staff and 60 months for part-time students. Extensions to the approval period can be requested.

If your research changes you might need to seek ethical approval for the amendments. Please request an amendment form.

We wish you every success with your project.

Prof Carol Haigh and Prof Jois Stansfield
Chair and Deputy Chair
Faculty Academic Ethics Committee

Ethics approval for Study 4: Manchester Metropolitan University

Manchester Metropolitan University

M E M O R A N D U M

FACULTY ACADEMIC ETHICS COMMITTEE

Faculty of Health, Psychology & Social Care

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53 Bonsall Street
Manchester
M15 6GX

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To: May Agius

From: Prof Carol Haigh

Date: 31/10/2017

Subject: Ethics Application 1285

Title: Clinical decision making for children with autism spectrum disorder who require augmentative and alternative communication

---

Thank you for your application for a second amendment to your original ethical approval.

The Faculty Academic Ethics Committee review process has recommended approval of your amendment. This approval is granted for 42 months for full-time students or staff and 60 months for part-time students. Extensions to the approval period can be requested.

If your research changes you might need to seek ethical approval for the amendments. Please request an amendment form.

We wish you every success with your project.

Prof Carol Haigh
Chair
Faculty Academic Ethics Committee

Ethics approval: University of Malta

Manchester

UNIVERSITY OF MALTA

UNIVERSITY RESEARCH ETHICS COMMITTEE

Check list to be included with UREC proposal form

Please make sure to tick **ALL** the items. Incomplete forms will not be accepted.

		YES	NOT APP.
1a.	Recruitment letter / Information sheet for subjects, in English	✓	
1b.	Recruitment letter / Information sheet for subjects, in Maltese	✓	
2a	Consent form, in English, signed by supervisor, and including your contact details	✓	
2b	Consent form, in Maltese, signed by supervisor, and including your contact details	✓	
3a	In the case of children or other vulnerable groups, consent forms for parents/ guardians, in English	✓	
3b	In the case of children or other vulnerable groups, consent forms for parents/ guardians, in Maltese	✓	
4a	Tests, questionnaires, interview or focus group questions, etc, in English		✓
4b	Tests, questionnaires, interview or focus group questions, etc, in Maltese		✓
5a	Other institutional approval *for access to subjects*: Health Division, Directorate for Quality and Standards in Education, Department of Public Health, Curia...	✓	
5b	Other institutional approval *for access to data*: Registrar, Data Protection Officer Health Division/Hospital, Directorate for Quality and Standards in Education, Department of Public Health...		✓
5c	Approval from person *directly responsible for subjects*: Medical Consultants, Nursing Officers, Head of School...	✓	

Received by Faculty office on	
Discussed by Faculty Research Ethics Committee on	
Discussed by university Research Ethics Committee on	17.7.15

To be completed by Faculty Research Ethics Committee

We have examined the above proposal and advise

Acceptance **Refusal** **Conditional acceptance**

For the following reason/s:

Signature Date

To be completed by University Research Ethics Committee

We have examined the above proposal and grant

Acceptance **Refusal** **Conditional acceptance**

For the following reason/s:

Signature Date 17/7/15

Permissions: Ministry of Education, Malta

Appendix 1.

DIRETTORAT GHAL SERVIZZI EDUKATTIVI
DIPARTIMENT SERVIZZI GHALL-ISTUDENT
TRIQ FRA GAETANO PACE FORNO,
HAMRUN HMR 1100

TEL: 21228349 / 50

MALTA

DIRECTORATE FOR EDUCATIONAL SERVICES
STUDENT SERVICES DEPARTMENT
FRA GAETANO PACE FORNO STREET,
HAMRUN HMR 1100

FAX: 21233513

May Agius,
Senior Speech and Language Therapist,
ACTU,
Students Services Department Fra Pace Forno Gaetano Road,
Hamrun HMR1100

02/04/2015

Re: Request to work with children at ACTU for Dissertation project

Dear Ms Agius,

I am approving your request to work with a maximum of 16 children with a diagnosis of Autistic Spectrum Disorder who are currently accessing ACTU services at the Student Services Department in Hamrun. I understand that the data gathered will be used for your dissertation project which you are carrying out in fulfilment of your PhD at Manchester Metropolitan University.

Yours Sincerely

Mr George Said-Zammit
Director
Student Services Department

Appendix 2.

DIRETTORAT GHAL KWALITA' U STANDARDS FL-EDUKAZZJONI
FURJANA VLT 2000
MALTA

DIRECTORATE FOR QUALITY AND STANDARDS IN EDUCATION
FLORIANA VLT 2000
MALTA

Request for Research in State Schools

A. (Please use BLOCK LETTERS)

Surname: AGIUS Name: MAY

I.D. Card Number: 359188M

Telephone No: 21255876 · Mobile No: 99161444 ·

Address: 173 Flt 6 Rudolph St Sliema

Locality: Sliema Post Code: SLM 1276

E-mail Address: may-agius@gov.mt

Faculty: Faculty of Health, Psychology + Social Care Course: PhD Year Ending: May 2019

Manchester Metropolitan University

Title of Research: Clinical decision making on non-verbal children with autism spectrum disorder who require augmentative and alternative communication.

Aims of research: ☐ Long Essay ☐ Dissertation ☐ Thesis ☐ Publication

Time Frame: 2yrs Language Used: English

Description of methodology: ~~A~~ Single Case Study: Multiple Baseline across Participants Design.

School/s where research is to be carried out: ACTU (Access to Communication + Technology Unit) at Student Services Dept in Hamrun.

Applicant is a therapist with this team.

Years / Forms: kinder class Age range of students: 2 – 5yrs.

* Telephone and mobile numbers will only be used in strict confidence and will not be divulged to third parties.

I accept to abide by the rules and regulations re Research in State Schools and to comply with the Data Protection Act 2001.

Warning to applicants - Any false statement, misrepresentation of concealment of material fact on this form or any document presented in support of this application may be grounds for criminal prosecution.

Signature of applicant: [signature] Date: 03/06/15

B. Tutor's Approval (where applicable)

The above research work is being carried out under my supervision.

Tutor's Name: DR JANICE MURRAY Signature: [signature]

Faculty: HEALTH, PSYCHOLOGY & SOCIAL CARE Faculty Stamp: MANCHESTER METROPOLITAN UNIVERSITY

C. Directorate for Quality and Standards in Education - Official Approval

The above request for permission to carry out research in State Schools is hereby approved according to the official rules and regulations, subject to approval from the University of Malta Ethics Committee.

RESEARCH AND DEVELOPMENT
DEPARTMENT
Ministry for Education and Employment
Floriana VLT 2000

[signature] Date: 17/06/2015 Official Stamp

Director
(Research and Development Department)

Louis Scerri
Assistant Director
Research and Development
Department

Conditions for the approval of a request by a student to carry out research work in State Schools

Permission for research in State Schools is subject to the following conditions:

1. The official request form is to be accompanied by a copy of the questionnaire and / or any relevant material intended for use in schools during research work.
2. The original request form, showing the relevant signatures and approval, must be presented to the Head of School.
3. All research work is carried out at the discretion of the relative Head of School and subject to their conditions.
4. Researchers are to observe strict confidentiality at all times.
5. The Directorate for Quality and Standards in Education reserves the right to withdraw permission to carry out research in State Schools at any time and without prior notice.
6. Students are expected to restrict their research to a minimum of students / teachers / administrators / schools, and to avoid any waste of time during their visits to schools.
7. As soon as the research in question is completed, the Directorate for Quality and Standards in Education assumes the right to a full copy (in print/on C.D.) of the research work carried out in State Schools. **Researchers are to forward the copies to the Assistant Director, International Research, Directorate for Quality and Standards in Education.**
8. Researchers are to hand a copy of their Research in print or on C.D. to the relative Schools.
9. In the case of video recordings, researchers have to obtain prior permission from the Head of School and the teacher of the class concerned. Any adults recognisable in the video are to give their explicit consent. Parents of students recognisable in the video are also to be requested to aprove that their siblings may be video-recorded. Two copies of the consent forms are necessary, one copy is to be deposited with the Head of School, and the other copy is to accompany the Request Form for Research in State Schools. Once the video recording is completed, one copy of the videotape is to be forwarded to the Head of School. The Directorate for Quality and Standards in Education reserves the right to request another copy.
10. The video recording's use is to be limited to this sole research and may not be used for other research without the full consent of interested parties including the Directorate for Quality and Standards in Education.

Appendix 2

Information and consent sheets: Studies 1-4

English information sheet for parents/carers: Studies 1 and 2

Date: _____

Information Sheet

Research Project Title:

Supporting children with Autistic Spectrum Disorder to ask for things they want using pictures.

Introduction:

You and your child are being invited to take part in a research project being carried out at Access to Communication and Technology Unit (ACTU). Before you decide if you and your child will take part in the project it is important for you to understand why the research is being done and what it will involve. Please take some time to read the following information carefully and feel free to talk to others about it if you want to. Ask me if you need more information. Take time to decide if you do or do not want to take part in the study. Thank you for taking the time to read this.

Purpose of the Project:

Some children with a diagnosis of autism benefit from the use of AAC (Augmentative and Alternative Communication) to support their communication as they have not yet developed speech. One of the ways we help the children to communicate is to use at ACTU is symbols to represent things that the child might want to ask for. One system that we use is an iPad on which pictures can be selected. Pictures can be presented on the app in a grid format or as a visual scene. In a grid format, the things the child might want to ask for are usually arranged in rows and columns. In a visual scene, the things the child might want

are usually presented as a photo scene. We would like to see if scenes will be as useful as or more useful than grid formats in teaching children who attend the Unit to communicate

This is a project which will be used to try out ways that we can teach children with autism to ask for things using the visual scene display.

The purpose of this project is to compare using grid displays with visual scene displays using the iPad App for teaching children with autism to ask for things. We want to see if the use of the visual scene displays will be an improvement over our usual practice (which is the use of grid format).

Why has my child been chosen?

Your child has been chosen to take part in the study because s/he is aged 6 or less, has a diagnosis of autism from a psychologist, has not received any prior iPad training for communication, and does not use words or uses less than 10 words to communicate. All together a maximum of 4 children will be taking part in the study.

Does my child have to take part in the study?

It is up to you to decide if you would like your child to take part in the study. If you do decide to allow him/her to take part you will be given this information sheet to keep and you will also be asked to sign a consent form. You can withdraw your child from the study at any time and you do not have to give a reason. If you choose not to allow your child to take part in the study this will not affect his/her entitlement to services, and s/he will receive the usual service from ACTU. If you do allow your child to participate at the end of the project we will resume our usual work with you and your child.

What will happen if I allow my child to take part?

The project will last between 16 and 20 weeks depending on the progress your child makes in the project. You will be given 3 appointments a week each of which will last 20 minutes. Some sessions with your child will be videotaped so that we can measure how many times your child asks for items. You will be invited to watch your child in all the sessions.

During the first weeks I will assess your child's communication skills using some standard activities. This will include an assessment of your child's understanding of language which will be assessed by asking your child to point to some pictures. I will also assess how your child is communicating and the reasons he communicates. This will be done by observing your child in the sessions and by talking to you. You will be asked to complete a worksheet to help us to select vocabulary that we can use with your child. I will see which of the items or activities you choose are those most preferred by your child. We will also be assessing your child's level of autism. Your child will also be given the opportunity to ask for things using the iPad.

Your child will be taught to use the iPad app to ask for items over 6 weeks. On some days we will focus on teaching your child to ask for things using the grid format, on other days we will focus on the visual scene.

Will my child and I be recorded, and how will the recorded media be used?

Some sessions with your child will be video-recorded. These recordings will be used only for analysis so that we can measure how many times your child asks for things. No other use will be made of these recordings without your permission, and no one outside the project will be allowed access to the recordings. During the study the video recordings will be transferred to a portable hard drive where they will be kept in a password protected folder for analysis.

After the study is completed the video recordings will be transferred to a CD and kept in your child's ACTU file, as is the general practise for videos made with children who attend ACTU services.

In addition to the consent form for your child to participate in the project, you will also be asked to sign a form which is specified by the Education Directorate in order to allow video recordings to be made of your child during the sessions. This is in addition to the form which you filled out when you were referred to ACTU services.

What are the possible disadvantages and risks of taking part?

There are no known risks or disadvantages associated with the tasks and activities intended to be used in this project. The use of the iPad with a grid format to support communication is already being used at ACTU. The use of an iPad with a visual scene is a new innovation in this service. As this will be used within the same framework as we currently use for the iPad with the grid display no potential harm or distress is anticipated, however, we will monitor use of the iPad and if your child is in anyway unhappy with its use, the session will be ended.

What are the benefits to taking part in the study?

Your child will receive some training in using the iPad to ask for things. The use of the iPad with a visual scene is new and we don't know if there will be any advantage for your child in using this. We do know that the iPad with a grid display is beneficial in helping children with ASD to communicate. This study will provide us with useful information about how we can provide effective support for communication for children with ASD in the future. At the end of the study you and your child will receive the usual support offered by the Unit which will allow you to develop the use of the iPad at home and support for it to be used at school should you wish to continue using the iPad to support your child's communication (if your child attends school). Should you decide that you would like to discuss other methods of supporting your child to communicate this will also be possible.

What happens if the research study stops earlier than expected?

If for some reason the project is stopped earlier than expected you will be informed in writing and we will give you the reasons for this.

What if something goes wrong?

If you have any complaints about the study you can speak to May Agius by telephone on 21255876, or email her on may.agius.2@ilearn.edu.mt . Should you have any unresolved concerns about any aspect of this project, you may complain formally by contacting the project supervisor Professor Janice Murray by telephone on +44 (0) 161 2472570, or email her at j.murray@mmu.ac.uk at Manchester Metropolitan University.

Will my child's participation in this project be kept confidential?

All the information we will collect about your child will be kept strictly confidential. You and your child will not be identified in any reports or publications. The videos will be used only to gather information about how your child communicates during the sessions. They will not be used for any other purpose.

What will happen to the results of the research project?

The results of the research project will be included as part of my dissertation for a PhD) at Manchester Metropolitan University. The results may also be published in the local media as is required by MGSS (Malta Government Scholarship Scheme). The results of research may be published in academic journals.

Who is funding this project?

MGSS (postgraduate) have funded the PhD of which this project is a part. This scheme is administered by the Programme Implementation Directorate, Ministry of Education and Employment in Malta. For more information please look at https://education.gov.mt/en/education/myScholarship/Pages/MGSS-PG.aspx.

Who has ethically reviewed this project?

The project has been approved by the Department of Human Communication Sciences Research Ethics Review Panel within Manchester Metropolitan University. The project is also approved by UREC (University Research Ethics Committee) within the University of Malta.

Contact for further information:

Researcher:

May Agius
Senior Allied Health Professional
Speech and Language Therapist
ACTU
Student Services Department
Fra Pace Gaetano Forno Rd
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Maltese information sheet for parents/carers: Studies 1 and 2

Data: _____

Skeda Informattiva

It-Titlu tal-Proġett ta' Riċerka:

Użu ta’ simboli li jgħinu lit-tfal b’Autistic Spectrum Disorder sabiex jistaqsu għal affarijiet.

Introduzzjoni:

Int u t-tifel/tifla tiegħek mistiedna tieħdu sehem fi proġett ta' riċerka li qiegħed jitwettaq f'Access to Communication and Technology Unit (ACTU). Qabel tiddeċiedi jekk int u t-tifel/tifla tiegħek intomx ser tieħdu sehem fil-proġett, importanti li tifhem għaliex qed issir ir-riċerka u x'tinvolvi. Jekk jogħġbok, ħu ftit tal-ħin biex taqra bil-mod it-tagħrif li jmiss u tiddejjaqx titkellem ma' oħrajn dwaru jekk tixtieq. Jekk għandek bżonn iktar tagħrif, għidli. Ħu l-ħin tiegħek biex tiddeċiedi jekk tixtieqx tieħu sehem fl-istudju. Grazzi talli ħadt il-ħin biex taqra din l-informazzjoni.

L-Iskop tal-Proġett:

Nota: Minn hawn 'il quddiem ser jintuża l-plural 'tfal' għal raġunijiet ta' simplifikazzjoni, iżda dan il-plural ser ikun qed jirreferi għat-tifel/tifla individwali.

Uħud mit-tfal dijanjostikati b’awtiżmu jibbenefikaw mill-użu ta' AAC (*Augmentative and Alternative Communication* - Komunikazzjoni Awmentattiva u Alternattiva) bħala appoġġ għall-komunikazzjoni tagħhom peress li ma jkunux għadhom żviluppaw il-kapaċità tat-taħdit. Wieħed mill-modi li bih ngħinu lit-tfal jikkomunikaw huwa bl-użu tas-simboli li jirrappreżentaw affarijiet li forsi t-tfal ikunu jixtiequ jitolbu. Sistema minnhom li nużaw f’ACTU hija billi nużaw iPad b’app minn fejn it-tfal jistgħu jagħżlu stampi. L-istampi jistgħu jiġu ppreżentati fuq l-app ġo grid jew f’xena viżwali. Meta l-istampi jkunu ġo grid, l-affarijiet li t-tfal iridu

jistaqsu għalihom normalment ikunu irranġata f'kolonni u fillieri. F'xena viżwali, l-affarijiet li t-tfal iridu jistaqsu għalihom ikunu ppreżentati bħala ritratt. Aħna nixtiequ inkunu nafu jekk x-xena viżwali tkun aħjar jew l-istess bħal format tal-grid meta inkunu qegħdin ngħallmu lit-tfal li jiġu l-ACTU biex jikkomunikaw.

L-skop tal-proġett huwa li inqabblu l-użu tal-grid max-xena viżwali fuq l-app tal-iPad biex it-tfal jistaqsu għall-affarijiet. Nixtiequ nkunu nafu jekk l-użu tax-xena viżwali tkun aħjar minn kif naħdmu s-soltu (bl-użu tal-grid).

Għaliex intgħażlu t-tfal tiegħi?

It-tfal tiegħek intgħażlu biex jieħdu sehem fl-istudju għaliex għandhom 6 snin jew inqas, għandhom dijanjosi ta' awtiżmu minn psikologu, għadhom qatt ma rċevew taħriġ fuq l-iPad, u ma jużawx kliem jew jużaw inqas minn għaxar kelmiet biex jikkomunikaw. B'kollox, fl-istudju pilota ser jieħdu sehem massimu t'erbat itfal.

It-tfal tiegħi bilfors iridu jieħdu sehem fl-istudju?

Huwa f'idejk li tiddeċiedi jekk tixtieqx li t-tfal tiegħek jieħdu sehem fl-istudju. Jekk fil-fatt tiddeċiedi li tħallihom jieħdu sehem, ser tingħata din l-iskeda informattiva biex iżżommha u inti ser tintalab tiffirma formola ta' kunsens ukoll. Tista' tirtira lit-tfal tiegħek mill-istudju fi kwalunkwe mument u m'għandekx għalfejn tagħti raġuni. Jekk tagħżel li ma tħallix lit-tfal tiegħek jieħdu sehem fl-istudju, dan mhux ser jaffettwa l-intitolament tagħhom għas-servizzi, u ser jibqgħu jirċievu s-servizz tas-soltu mill-ACTU. Jekk tħalli lit-tfal tiegħek jieħdu sehem, fi tmiem il-proġett ser inkomplu bix-xogħol tas-soltu tagħna miegħek u mat-tfal tiegħek.

X'ser jiġri jekk inħalli lit-tfal tiegħi jieħdu sehem?

Il-proġett ser idum bejn 16 u 20 ġimgħat, skond il-progress li jaghmlu t-tfal. Ser tingħata 3 appuntamenti fil-ġimgħa u kull wieħed minnhom ser ghoxrin minuti. Xi ftit mis-sessjonijiet mat-tfal tiegħek sejrin jiġu rrekordjati fuq vidjow sabiex inkunu nistgħu ngħoddu kemm-il darba t-tfal tiegħek jitolbu oġġetti. Int ser tkun mistieden/mistiedna tosserva lit-tfal tiegħek fis-sessjonijiet kollha.

Matul l-ewwel ġimgħat sejrin nevalwaw il-ħiliet ta' komunikazzjoni tat-tfal tiegħek billi nużaw xi attivitajiet standard. Dawn sejrin jinkludu evalwazzjoni ta' kemm it-tfal tiegħek jifhmu l-lingwa, ħila li ser tiġi evalwata billi t-tfal tiegħek jintalbu jippuntaw b'subgħajhom lejn xi stampi. Ser nevalwa wkoll kif it-tfal tiegħek qed jikkomunikaw u r-raġunijiet għaliex jikkomunikaw. Dan ser isir billi nosserva lit-tfal tiegħek fis-sessjonijiet u billi nitkellem miegħek. Ser tintalab timla skeda biex tgħinna nagħżlu vokabolarju li nistgħu nużaw mat-tfal tiegħek. Ser naraw liema mill-oġġetti jew l-attivitajiet li tagħżel int huma l-iktar ippreferuti mit-tfal tiegħek. Ser nassessjaw il-livell t'awtizmu u 's-sensory issues' fit-tfal tiegħek. Ser nagħtu ċ-ċans li t-tfal ser jistaqsu għall-affarijiet bl-użu tal-app fuq l-iPad.

Matul l-6 ġimgħat ta' wara, it-tfal tiegħek ser jiġu mgħallma kif jużaw l-app għall-iPad biex jitolbu affarijiet. Ser ikun hemm ġranet fejn ser nkunu qed nużaw il-grid biex it-tfal isaqsu għall-affarijiet, u fi ġranet oħra ser nużaw ix-xena viżwali.

Matul l-aħħar ġimgħa, it-tfal tiegħek sejrin ikunu kapaċi jagħżlu jekk jużaw il-grid jew ix-xena viżwali fuq l-iPad u ser isiru evalwazzjonijiet oħrajn tal-komunikazzjoni.

Jien u t-tfal tiegħi ser niġu rrekordjati? U kif ser tintuża l-midja rrekordjata?

Xi-sessjonijiet mat-tfal tiegħek sejrin jiġu rrekordjati fuq vidjow. Dawn ir-reġistrazzjonijiet sejrin jintużaw biss għal analiżi sabiex inkunu nistgħu ngħoddu kemm-il darba t-tfal tiegħek talbu affarijiet. Mhu se jsir l-ebda użu ieħor minn dawn ir-reġistrazzjonijiet mingħajr il-permess tiegħek, u ħadd ieħor barra dan il-proġett ma huwa ser jingħata aċċess għar-reġistrazzjonijiet. Matul l-istudju, ir-reġistrazzjonijiet fuq vidjow sejrin jiġu ttrasferiti fuq hard disk portabbli fejn sejrin jinżammu f'folder protett b'password biex jiġu analizzati.

Wara li jintemm l-istudju, ir-reġistrazzjonijiet fuq vidjow sejrin jiġu ttrasferiti fuq CD u sejrin jinżammu fil-fajl t'ACTU tat-tfal tiegħek, bħalma jsir fil-prattika tas-soltu għall-vidjows li jsiru mat-tfal li jattendu għas-servizzi tal-ACTU.

Minbarra l-formola ta' kunsens sabiex it-tfal tiegħek jieħdu sehem fil-proġett, ser tintalab tiffirma wkoll formola li hija speċifikata mid-Direttorat tal-Edukazzjoni biex ikunu jistgħu jsiru reġistrazzjonijiet fuq vidjo tat-tfal tiegħek matul is-sessjonijiet. Din hija formola oħra separata minn dik li diġà mlejt meta rreferewk għas-servizzi tal-ACTU.

X'inhuma l-iżvantaġġi u r-riskji possibbli assoċjati mal-parteċipazzjoni?

M'hemm l-ebda riskju jew żvantaġġ magħruf assoċjat max-xogħol u l-attivitajiet li għandhom jintużaw f'dan il-proġett. Diġa qegħdin nużaw il-grid fuq l-iPad biex ngħallmu lit-tfal jikkomunikaw f'ACTU. L-użu tax-xena viżwali fuq l-iPad hija nnovazzjoni ġdida f'dan is-servizz. Peress li din ser tintuża fi ħdan l-istess kuntest li fih bħalissa nużaw il-grid, m'hija mistennija l-ebda ħsara jew problema. Madankollu, sejrin inkunu qed inżommu għajnejna fuq ix-xena viżwali fuq l-iPad, u jekk it-tfal tiegħek jiddejqu b'xi mod minħabba l-użu tiegħu, is-sessjoni tintemm.

X'inhuma l-benefiċċji tal-parteċipazzjoni fl-istudju?

It-tfal tiegħek ser jirċievu xi taħriġ fl-użu fuq kif jistgħu jużaw l-app għall-iPad biex jistaqsu għall-affarijiet. L-użu tax-xena viżwali hija ġdid u ma nafux jekk hux ser ikun hemm xi vantaġġ għat-tfal tiegħek meta jużawha. Tabilħaqq nafu li t-taħriġ fuq il-grid tal-iPad huwa ta' benefiċċju biex it-tfal b'awtiżmu jiġu megħjuna jikkomunikaw. Dan l-istudju ser jipprovdilna informazzjoni utli dwar kif nistgħu nipprovdu appoġġ effettiv għall-komunikazzjoni lit-tfal b'awtiżmu fil-ġejjieni. Fi tmiem l-istudju, int u t-tfal tiegħek ser tirċievu l-appoġġ tas-soltu offrut mit-Taqsima li ser tħallik tiżviluppa l-użu tal-iPad fid-dar kif ukoll l-appoġġ biex din tintuża l-iskola (jekk it-tfal tiegħek imorru l-iskola). Jekk tiddeċidi li tixtieq tiddiskuti metodi oħrajn ta' kif nistgħu ngħinu lit-tfal tagħkom jikkomunikaw dan ikun possibbli.

X'jiġri jekk l-istudju ta' riċerka jieqaf qabel iż-żmien mistenni?

Jekk għal xi raġuni l-proġett jitwaqqaf qabel id-data mistennija, int ser tiġi mgħarraf/mgħarrfa bil-miktub u ser nipprovdulek ir-raġunijiet għal dan.

U x'jiġri jekk xi ħaġa tmur ħażin?

Jekk ikollok xi tħassib dwar kwalunkwe aspett ta' dan il-proġett, tista' tikkuntattja lis-Sinj. tal-proġett, May Agius bit-telefown fuq 21255876, jew inkella tista' tibgħatilha email fuq may.agius.2@ilearn.edu.mt. Jekk xorta tixtieq titkellem ma xi ħadd ieħor fuq il-proġett, tista' tikkuntattja lis-supervisor tal-proġett: Professor Janice Murray bit-telfown fuq +44 (0) 161 2472570 jew ibgħatilha email fuq: j.murray@mmu.ac.uk f'Manchester Metropolitan University.

Il-parteċipazzjoni tat-tfal tiegħi f'dan il-proġett ser tinżamm kunfidenzjali?

L-informazzjoni kollha li niġbru dwar it-tfal tiegħek ser jinżammu strettament kunfidenzjali. Int u t-tfal tiegħek ma intom sejrin tiġu identifikati fl-ebda rapport jew pubblikazzjoni. Il-vidjows sejrin jintużaw biss biex tinġabar informazzjoni dwar kif it-tfal tiegħek jikkomunikaw matul is-sessjonijiet. Mhumiex ser jintużaw għal xi skop ieħor.

X'ser jiġri mir-riżultati tal-proġett ta' riċerka?

Ir-riżultati tal-proġett ta' riċerka sejrin jiġu inklużi bħala parti mid-dissertazzjoni tiegħi għal PhD f'Manchester Metropolitan University. Ir-riżultati jistgħu jiġu ppubblikati wkoll fil-midja lokali kif inhu meħtieġ minn MGSS (Postgraduate Malta Government Scholarship Scheme).

Min qiegħed jiffinanzja dan il-proġett?

L-iskema MDSS iffinanzjat il-lawrea tal-PhD li dan il-proġett jagħmel parti minnha. Din l-iskema hija amministrata mid-Direttorat tal-Implimentazzjoni tal-Programmi, il-Ministeru tal-Edukazzjoni u x-Xogħol (*Programme Implimentation Directorate, Ministry of Education and Employment*) f'Malta. Għal iktar tagħrif, jekk jogħġbok

idħol fuq http://education.gov.mt/en/education/myScholarship/Pages/MGSS-PG.aspx

Min ivverifika l-etika ta' dan il-proġett?

Il-proġett ġie approvat mid-'Department of Human Communication Sciences Research Ethics Review Panel f'Manchester Metropolitan University u UREC (University Research Ethics Committee) fi ħdan l-universita' ta' Malta.

Kuntatti għal iktar tagħrif:

Riċerkatriċi:

May Agius
Senior Allied Health Professional
Speech and Language Therapist
ACTU
Student Services Department
Triq Fra Pace Gaetano Forno
Il-Ħamrun
Malta
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Superviżur:

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Study 3: Participant information sheet

Decision-making for children with autism spectrum disorder who require augmentative and alternative communication

You are invited to take part in an interview as a follow-up to your involvement in the 2 intervention studies which you have provided intervention. Before you decide you need to understand why you are being asked to participate in this interview and what it would involve for you. Please take time to read the following information carefully. Ask questions if anything you read is not clear or would like more information. Take time to decide whether or not to take part.

What is the purpose of the interview?

You were involved in supporting the lead investigator to provide interventions which involved teaching pre-school children with a diagnosis of Autism Spectrum Disorder to ask for things they wanted using an iPad as an Augmentative and Alternative Communication (AAC) device. In the study you also assessed the participants' sensory processing and planned and implemented interventions to target this. This interview will be about your experiences in this study. The information will be used to provide direction to the next phase of research.

Why have I been invited?

You have been chosen to take part in this interview as you can provide information which directly relates to your experiences in providing interventions for the participants.

Do I have to take part?

The decision to take part in the interview is up to you. We will discuss the information sheet. You will then be asked to sign a consent form to show you agreed to take part. You are free to decline to take part in this interview. If you

agree to take part in this interview you may end the interview at any point or decide to decline to answer any question.

What will happen to me if I take part?

The interview will last about 1 hour. During the interview we will talk about children with a diagnosis of Autism Spectrum Disorder and implementing high tech AAC. We will also talk about sensory processing difficulties in this group of children.

The interview will be audio recorded so that we can talk freely without the need for me to take notes. The recording will be transcribed after the interview so that I can review what we talked about after the interview. All interview notes will be kept confidential and anonymous.

What are the possible disadvantages and risks of taking part?

There are no anticipated identified risks to taking part in this interview. If, however, you feel uncomfortable with any of the questions asked you are free to decline answering.

What are the possible benefits of taking part?

I cannot promise the study will help you but the information from your interview will help to improve how we provide interventions for children with Autism Spectrum disorder who are nonverbal and require AAC.

What if there is a problem?

If you have a concern about any aspect of the interview, you should ask to speak to the researcher, May Agius who will do her best to answer your questions (21255876).

If you remain unhappy and wish to complain formally you can do this by contacting the supervisor of this research project: Professor Janice Murray, Department of Health Professions, Faculty of Health Psychology and Social

Care, Brooks Building, Manchester Metropolitan University who can be contacted at **j.murray@mmu.ac.uk** and +44 (0)161 247 2570.

Will my taking part in the study be kept confidential?

All information collected during the interview will be kept strictly confidential.

Your interview will be audio recorded and this recording will be stored on a password protected computer known only to the researcher. This data will then be transcribed for analysis. The transcription will also be stored on a password protected computer only known to the researcher. The transcriptions will be accessed by the supervisory team if requested. The audio recording and transcription will be retained for the duration of this research project (end date November 2020) after which it will be erased.

What will happen if I don't carry on with the study?

If you decide to end the interview before all the questions have been asked you will be free to choose whether the recordings up to that point can be used by the researcher.

What will happen to the results of the research study?

The data from your interview will form part of this research study which may be published. You will not be identified in any report/publication without your consent.

Who is organising or sponsoring the research?

This research is funded by MGSS (Malta Government Scholarship Scheme).

Further information and contact details:

The Lead Researcher can be contacted as follows:

May Agius

Speech and Language Therapist

ACTU

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Hamrun
Malta
may.agius@stu.mmu.ac.uk
+356 21255876

Research Supervisor:
Professor Janice Murray
Department of Health Professions,
Faculty of Health Psychology and Social Care,
Brooks Building,
Manchester Metropolitan University
j.murray@mmu.ac.uk
+44 (0)161 247 2570.

Study 4: Quantitative study- Participant information sheet

English version information sheet for parents/carers for Study 4

Date: _____

Information Sheet

Research Project Title:

Supporting children with Autistic Spectrum Disorder to ask for things they want using pictures.

Introduction:

You and your child are being invited to take part in a research project being carried out at Access to Communication and Technology Unit (ACTU). Before you decide if you and your child will take part in the project it is important for you to understand why the research is being done and what it will involve. Please take some time to read the following information carefully and feel free to talk to others about it if you want to. Ask me if you need more information. Take time to decide if you do or do not want to take part in the study. Thank you for taking the time to read this.

Purpose of the Project:

Some children with a diagnosis of autism benefit from the use of AAC (Augmentative and Alternative Communication) to support their communication as they have not yet developed speech. One of the ways we help the children to communicate is to use at ACTU is symbols to represent things that the child might want to ask for. We would like to see if we can teach children who attend the Unit to communicate with an iPad being used as an AAC device.

This is a project which will be used to try out ways that we can teach children with autism to ask for things using the iPad.

The purpose of this project is to see if we can teach children with autism to ask for things.

Why has my child been chosen?

Your child has been chosen to take part in the study because s/he is aged 6 or less, has a diagnosis of autism from a psychologist, has not received any prior iPad training for communication, and does not use words or uses less than 10 words to communicate. Your child was also chosen because he has sensory processing difficulties. All together a maximum of 4 children will be taking part in the study.

Does my child have to take part in the study?

It is up to you to decide if you would like your child to take part in the study. If you do decide to allow him/her to take part you will be given this information sheet to keep and you will also be asked to sign a consent form. You can withdraw your child from the study at any time and you do not have to give a reason. If you choose not to allow your child to take part in the study this will not affect his/her entitlement to services, and s/he will receive the usual service from ACTU. If you do allow your child to participate at the end of the project we will resume our usual work with you and your child.

What will happen if I allow my child to take part?

The project will last between 16 and 20 weeks depending on the progress your child makes in the project. You will be given 3 appointments a week each of which will last 20 minutes. Some sessions with your child will be videotaped so that we can measure how many times your child asks for items. You will be invited to watch your child in all the sessions.

During the first weeks I will assess your child's communication skills using some standard activities. This will include an assessment of your child's understanding of language which will be assessed by asking your child to point to some pictures. I will also assess how your child is communicating and the reasons he communicates. This will be done by observing your child in the sessions and by talking to you. You will be asked to complete a worksheet to help us to select vocabulary that we can use with your child. I will see which of the items or activities you choose are those most preferred by your child. We will also be assessing your child's level of autism and sensory processing skills. Your child will also be given the opportunity to ask for things using the iPad.

Your child will be taught to use the iPad app to ask for items over 6 weeks

Will my child and I be recorded, and how will the recorded media be used?

Some sessions with your child will be video-recorded. These recordings will be used only for analysis so that we can measure how many times your child asks for things. No other use will be made of these recordings without your permission, and no one outside the project will be allowed access to the recordings. During the study the video recordings will be transferred to a portable hard drive where they will be kept in a password protected folder for analysis.

After the study is completed the video recordings will be transferred to a CD and kept in your child's ACTU file, as is the general practise for videos made with children who attend ACTU services.

In addition to the consent form for your child to participate in the project, you will also be asked to sign a form which is specified by the Education Directorate in order to allow video recordings to be made of your child during the sessions. This is in addition to the form which you filled out when you were referred to ACTU services.

What are the possible disadvantages and risks of taking part?

There are no known risks or disadvantages associated with the tasks and activities intended to be used in this project. The use of sensory based interventions are typically used by occupational therapists.

What are the benefits to taking part in the study?

Your child will receive some training in using the iPad to ask for things. The use of sensory based interventions with AAC interventions is new. We do know that the iPad with a grid display is beneficial in helping children with ASD to communicate. This study will provide us with useful information about how we can provide effective support for communication for children with ASD in the future. At the end of the study you and your child will receive the usual support offered by the Unit which will allow you to develop the use of the iPad at home and support for it to be used at school should you wish to continue using the iPad to support your child's communication (if your child attends school). Should you decide that you would like to discuss other methods of supporting your child to communicate this will also be possible.

What happens if the research study stops earlier than expected?

If for some reason the project is stopped earlier than expected you will be informed in writing and we will give you the reasons for this.

What if something goes wrong?

If you have any complaints about the study you can speak to May Agius by telephone on 21255876, or email her on may.agius.2@ilearn.edu.mt . Should you have any unresolved concerns about any aspect of this project, you may complain formally by contacting the project supervisor Professor Janice Murray by telephone on +44 (0) 161 2472570, or email her at j.murray@mmu.ac.uk at Manchester Metropolitan University.

Will my child's participation in this project be kept confidential?

All the information we will collect about your child will be kept strictly confidential. You and your child will not be identified in any reports or publications. The videos will be used only to gather information about how your child communicates during the sessions. They will not be used for any other purpose.

What will happen to the results of the research project?

The results of the research project will be included as part of my dissertation for a PhD) at Manchester Metropolitan University. The results may also be published in the local media as is required by MGSS (Malta Government Scholarship Scheme). The results of research may be published in academic journals.

Who is funding this project?

MGSS (postgraduate) have funded the PhD of which this project is a part. This scheme is administered by the Programme Implementation Directorate, Ministry of Education and Employment in Malta. For more information please look at https://education.gov.mt/en/education/myScholarship/Pages/MGSS-PG.aspx.

Who has ethically reviewed this project?

The project has been approved by the Department of Human Communication Sciences Research Ethics Review Panel within Manchester Metropolitan University. The project is also approved by UREC (University Research Ethics Committee) within the University of Malta.

Contact for further information:

Researcher:

May Agius
Senior Allied Health Professional
Speech and Language Therapist
ACTU

Student Services Department
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Supervisor:

Professor Janice Murray
Health Professions Department
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M15 6GX
Tel: 0161 2472570
Email: j.murray@mmu.ac.uk

Study 4: Quantitative study- Participant information sheet

Maltese version information sheet for parents/carers for Study 4

Data: _____

Skeda Informattiva

It-Titlu tal-Proġett ta' Riċerka:

Użu ta’ simboli li jgħinu lit-tfal b’Autistic Spectrum Disorder sabiex jistaqsu għal affarijiet.

Introduzzjoni:

Int u t-tifel/tifla tiegħek mistiedna tieħdu sehem fi proġett ta' riċerka li qiegħed jitwettaq f'Access to Communication and Technology Unit (ACTU). Qabel tiddeċiedi jekk int u t-tifel/tifla tiegħek intomx ser tieħdu sehem fil-proġett, importanti li tifhem għaliex qed issir ir-riċerka u x'tinvolvi. Jekk jogħġbok, ħu ftit tal-ħin biex taqra bil-mod it-tagħrif li jmiss u tiddejjaqx titkellem ma' oħrajn dwaru jekk tixtieq. Jekk għandek bżonn iktar tagħrif, għidli. Ħu l-ħin tiegħek biex tiddeċiedi jekk tixtieqx tieħu sehem fl-istudju. Grazzi talli ħadt il-ħin biex taqra din l-informazzjoni.

L-Iskop tal-Proġett:

Nota: Minn hawn 'il quddiem ser jintuża l-plural 'tfal' għal raġunijiet ta' simplifikazzjoni, iżda dan il-plural ser ikun qed jirreferi għat-tifel/tifla individwali.

Uħud mit-tfal dijanjostikati b’awtiżmu jibbenefikaw mill-użu ta' AAC (*Augmentative and Alternative Communication* - Komunikazzjoni Awmentattiva u Alternattiva) bħala appoġġ għall-komunikazzjoni tagħhom peress li ma jkunux għadhom żviluppaw il-kapaċità tat-taħdit. Wieħed mill-modi li bih ngħinu lit-tfal jikkomunikaw huwa bl-użu tas-simboli li jirrappreżentaw affarijiet li forsi t-tfal

ikunu jixtiequ jitolbu. Sistema minnhom li nużaw f'ACTU hija billi nużaw iPad b'app minn fejn it-tfal jistgħu jagħżlu stampi.

L-skop tal-proġett huwa li naghlmu it-tifel tieghek kif uża l-app tal-iPad biex it-tfal jistaqsu għall-affarijiet.

Għaliex intgħażlu t-tfal tiegħi?

It-tfal tiegħek intgħażlu biex jieħdu sehem fl-istudju għaliex għandhom 6 snin jew inqas, għandhom dijanjosi ta' awtiżmu minn psikologu, għadhom qatt ma rċevew taħriġ fuq l-iPad, u ma jużawx kliem jew jużaw inqas minn għaxar kelmiet biex jikkomunikaw. B'kollox, fl-istudju pilota ser jieħdu sehem massimu t'erbat itfal.

It-tfal tiegħi bilfors iridu jieħdu sehem fl-istudju?

Huwa f'idejk li tiddeċiedi jekk tixtieqx li t-tfal tiegħek jieħdu sehem fl-istudju. Jekk fil-fatt tiddeċiedi li tħallihom jieħdu sehem, ser tingħata din l-iskeda informattiva biex iżżommha u inti ser tintalab tiffirma formola ta' kunsens ukoll. Tista' tirtira lit-tfal tiegħek mill-istudju fi kwalunkwe mument u m'għandekx għalfejn tagħti raġuni. Jekk tagħżel li ma tħallix lit-tfal tiegħek jieħdu sehem fl-istudju, dan mhux ser jaffettwa l-intitolament tagħhom għas-servizzi, u ser jibqgħu jirċievu s-servizz tas-soltu mill-ACTU. Jekk tħalli lit-tfal tiegħek jieħdu sehem, fi tmiem il-proġett ser inkomplu bix-xogħol tas-soltu tagħna miegħek u mat-tfal tiegħek.

X'ser jiġri jekk inħalli lit-tfal tiegħi jieħdu sehem?

Il-proġett ser idum bejn 16 u 20 ġimgħat, skond il-progress li jaghmlu t-tfal. Ser tingħata 3 appuntamenti fil-ġimgħa u kull wieħed minnhom ser ghoxrin minuti. Xi ftit mis-sessjonijiet mat-tfal tiegħek sejrin jiġu rrekordjati fuq vidjow sabiex inkunu nistgħu ngħoddu kemm-il darba t-tfal tiegħek jitolbu oġġetti. Int ser tkun mistieden/mistiedna tosserva lit-tfal tiegħek fis-sessjonijiet kollha.

Matul l-ewwel ġimgħat sejrin nevalwaw il-ħiliet ta' komunikazzjoni tat-tfal tiegħek billi nużaw xi attivitajiet standard. Dawn sejrin jinkludu evalwazzjoni ta' kemm it-

tfal tiegħek jifhmu l-lingwa, ħila li ser tiġi evalwata billi t-tfal tiegħek jintalbu jippuntaw b'subgħajhom lejn xi stampi. Ser nevalwa wkoll kif it-tfal tiegħek qed jikkomunikaw u r-raġunijiet għaliex jikkomunikaw. Dan ser isir billi nosserva lit-tfal tiegħek fis-sessjonijiet u billi nitkellem miegħek. Ser tintalab timla skeda biex tgħinna nagħżlu vokabolarju li nistgħu nużaw mat-tfal tiegħek. Ser naraw liema mill-oġġetti jew l-attivitajiet li tagħżel int huma l-iktar ippreferuti mit-tfal tiegħek. Ser nassessjaw il-livell t'awtizmu u 's-sensory issues' fit-tfal tiegħek. Ser nagħtu ċ-ċans li t-tfal ser jistaqsu għall-affarijiet bl-użu tal-app fuq l-iPad.

Matul l-6 ġimgħat ta' wara, it-tfal tiegħek ser jiġu mgħallma kif jużaw l-app għall-iPad biex jitolbu affarijiet. Ser ikun hemm ġranet fejn ser nkunu qed nużaw il-grid biex it-tfal isaqsu għall-affarijiet.

Jien u t-tfal tiegħi ser niġu rrekordjati? U kif ser tintuża l-midja rrekordjata?

Xi-sessjonijiet mat-tfal tiegħek sejrin jiġu rrekordjati fuq vidjow. Dawn ir-reġistrazzjonijiet sejrin jintużaw biss għal analiżi sabiex inkunu nistgħu ngħoddu kemm-il darba t-tfal tiegħek talbu affarijiet. Mhu se jsir l-ebda użu ieħor minn dawn ir-reġistrazzjonijiet mingħajr il-permess tiegħek, u ħadd ieħor barra dan il-proġett ma huwa ser jingħata aċċess għar-reġistrazzjonijiet. Matul l-istudju, ir-reġistrazzjonijiet fuq vidjow sejrin jiġu ttrasferiti fuq hard disk portabbli fejn sejrin jinżammu f'folder protett b'password biex jiġu analizzati.

Wara li jintemm l-istudju, ir-reġistrazzjonijiet fuq vidjow sejrin jiġu ttrasferiti fuq CD u sejrin jinżammu fil-fajl t'ACTU tat-tfal tiegħek, bħalma jsir fil-prattika tas-soltu għall-vidjows li jsiru mat-tfal li jattendu għas-servizzi tal-ACTU.

Minbarra l-formola ta' kunsens sabiex it-tfal tiegħek jieħdu sehem fil-proġett, ser tintalab tiffirma wkoll formola li hija speċifikata mid-Direttorat tal-Edukazzjoni biex ikunu jistgħu jsiru reġistrazzjonijiet fuq vidjo tat-tfal tiegħek matul is-sessjonijiet.

Din hija formola oħra separata minn dik li diġà mlejt meta rreferewk għas-servizzi tal-ACTU.

X'inhuma l-iżvantaġġi u r-riskji possibbli assoċjati mal-parteċipazzjoni?

M'hemm l-ebda riskju jew żvantaġġ magħruf assoċjat max-xogħol u l-attivitajiet li għandhom jintużaw f'dan il-proġett. Diġa qegħdin nużaw il-grid fuq l-iPad biex ngħallmu lit-tfal jikkomunikaw f'ACTU. L-użu tax-xena viżwali fuq l-iPad hija nnovazzjoni ġdida f'dan is-servizz. Peress li din ser tintuża fi ħdan l-istess kuntest li fih bħalissa nużaw il-grid, m'hija mistennija l-ebda ħsara jew problema. Madankollu, it-tfal tiegħek jiddejqu b'xi mod minħabba l-użu tiegħu, is-sessjoni tintemm.

X'inhuma l-benefiċċji tal-parteċipazzjoni fl-istudju?

It-tfal tiegħek ser jirċievu xi taħriġ fl-użu fuq kif jistgħu jużaw l-app għall-iPad biex jistaqsu għall-affarijietTabilħaqq nafu li t-taħriġ fuq il-grid tal-iPad huwa ta' benefiċċju biex it-tfal b'awtiżmu jiġu megħjuna jikkomunikaw. Dan l-istudju ser jipprovdilna informazzjoni utli dwar kif nistgħu nipprovdu appoġġ effettiv għall-komunikazzjoni lit-tfal b'awtiżmu fil-ġejjieni. Fi tmiem l-istudju, int u t-tfal tiegħek ser tirċievu l-appoġġ tas-soltu offrut mit-Taqsima li ser tħallik tiżviluppa l-użu tal-iPad fid-dar kif ukoll l-appoġġ biex din tintuża l-iskola (jekk it-tfal tiegħek imorru l-iskola). Jekk tiddeċidi li tixtieq tiddiskuti metodi oħrajn ta' kif nistgħu ngħinu lit-tfal tagħkom jikkomunikaw dan ikun possibbli.

X'jiġri jekk l-istudju ta' riċerka jieqaf qabel iż-żmien mistenni?

Jekk għal xi raġuni l-proġett jitwaqqaf qabel id-data mistennija, int ser tiġi mgħarraf/mgħarrfa bil-miktub u ser nipprovdulek ir-raġunijiet għal dan.

U x'jiġri jekk xi ħaġa tmur ħażin?

Jekk ikollok xi tħassib dwar kwalunkwe aspett ta' dan il-proġett, tista' tikkuntattja lis-Sinj. tal-proġett, May Agius bit-telefown fuq 21255876, jew inkella tista' tibgħatilha email fuq may.agius.2@ilearn.edu.mt. Jekk xorta tixtieq titkellem ma

xi ħadd ieħor fuq il-proġett, tista' tikkuntattja lis-supervisor tal-proġett: Professor Janice Murray bit-telfown fuq +44 (0) 161 2472570 jew ibgħatilha email fuq: j.murray@mmu.ac.uk f'Manchester Metropolitan University.

Il-parteċipazzjoni tat-tfal tiegħi f'dan il-proġett ser tinżamm kunfidenzjali?

L-informazzjoni kollha li niġbru dwar it-tfal tiegħek ser jinżammu strettament kunfidenzjali. Int u t-tfal tiegħek ma intom sejrin tiġu identifikati fl-ebda rapport jew pubblikazzjoni. Il-vidjows sejrin jintużaw biss biex tinġabar informazzjoni dwar kif it-tfal tiegħek jikkomunikaw matul is-sessjonijiet. Mhumiex ser jintużaw għal xi skop ieħor.

X'ser jiġri mir-riżultati tal-proġett ta' riċerka?

Ir-riżultati tal-proġett ta' riċerka sejrin jiġu inklużi bħala parti mid-dissertazzjoni tiegħi għal PhD f'Manchester Metropolitan University. Ir-riżultati jistgħu jiġu ppubblikati wkoll fil-midja lokali kif inhu meħtieġ minn MGSS (Postgraduate Malta Government Scholarship Scheme).

Min qiegħed jiffinanzja dan il-proġett?

L-iskema MDSS iffinanzjat il-lawrea tal-PhD li dan il-proġett jagħmel parti minnha. Din l-iskema hija amministrata mid-Direttorat tal-Implimentazzjoni tal-Programmi, il-Ministeru tal-Edukazzjoni u x-Xogħol (*Programme Implimentation Directorate, Ministry of Education and Employment*) f'Malta. Għal iktar tagħrif, jekk jogħġbok idħol fuq http://education.gov.mt/en/education/myScholarship/Pages/MGSS-PG.aspx

Min ivverifika l-etika ta' dan il-proġett?

Il-proġett ġie approvat mid-'Department of Human Communication Sciences Research Ethics Review Panel f'Manchester Metropolitan University u UREC (University Research Ethics Committee) fi ħdan l-universita' ta' Malta.

Kuntatti għal iktar tagħrif:

Riċerkatriċi:

May Agius
Senior Allied Health Professional
Speech and Language Therapist
ACTU
Student Services Department
Triq Fra Pace Gaetano Forno
Il-Ħamrun
Malta
linja diretta: 00356-21255876
may.agius@ilearn.edu.mt

Superviżur:

Professor Janice Murray
Health Professions Department
Birley Building
Birley Fields Campus,
53 Bonsall Street,
Manchester,
M15, 6GX
linja diretta: +44 (0) 161 247570
j.murray@mmu.ac.uk

Participant Information Sheet: Study 4 Focus Group

Study Title

Decision-making for children with autism spectrum disorder who require augmentative and alternative communication

You are invited to take part in the final phase of an intervention project in which four children with a diagnosis of ASC will be taught to use a voice output communication aid to request. Before you decide you need to understand why you are being asked to participate in this interview and what it would involve for you. Please take time to read the following information carefully. Ask questions if anything you read is not clear or would like more information. Take time to decide whether or not to take part.

What is the purpose of my involvement in this project?

The purpose of your involvement is to provide insight into how the clinicians interact with the children with ASC when providing AAC interventions.

Why have I been invited?

You have been chosen to take part in project as you have experience of providing AAC interventions to children diagnosed with ASC.

Do I have to take part?

The decision to take part in the interview is up to you. We will discuss the information sheet. You will then be asked to sign a consent form to show you agreed to take part. You are free to decline to take part in this project. If you agree to take part in this project you may end your involvement at any point.

What will happen to me if I take part?

Your involvement in this project will consist of 2 phases:

In Phase 1 you will be asked to observe the clinicians providing interventions to 4 children on 3 occasions for a duration of 10 minutes. After each session of 10 minutes you will be asked to keep a record of your observations in an electronic diary. You will be given some headings to help you organise your thoughts on your observations.

In Phase 2, you will be asked to attend a focus group lasting a maximum of 2 hrs with other participants who have also observed sessions on other occasions. During the focus groups you will be asked to look at your diary observations co that you can contribute to a discussion of how clinicians interact with children with ASC when providing AAC interventions.

What are the possible disadvantages and risks of taking part?

There are no anticipated identified risks to taking part in project. If, however, you feel uncomfortable with any of the questions asked in the focus group you are free to decline answering.

What are the possible benefits of taking part?

I cannot promise the study will help you but the information from your interview will help to improve how we provide interventions for children with Autism Spectrum Condition who are nonverbal and require AAC.

What if there is a problem?

If you have a concern about any aspect of the interview, you should ask to speak to the researcher, May Agius who will do her best to answer your questions (21255876).

If you remain unhappy and wish to complain formally you can do this by contacting the supervisor of this research project: Professor Janice Murray, Department of Health Professions, Faculty of Health Psychology and Social Care, Brooks Building, Manchester Metropolitan University who can be contacted at **j.murray@mmu.ac.uk** and +44 (0)161 247 2570 or or Professor Carol Haigh, Faculty Head of Ethics Faculty of Health Psychology and Social Care, Brooks Building, Manchester Metropolitan University **c.haigh@mmu.ac.uk** (independent contact)

Will my taking part in the study be kept confidential?

All information collected during the interview will be kept strictly confidential.

The diary entries will be stored on a password protected computer known only to the lead researcher. The focus group interview will be audio recorded and this recording will be stored on a password protected computer known only to the researcher. This data will then be transcribed for analysis. The transcription will also be stored on a password protected computer only known to the researcher. The transcriptions will be accessed by the supervisory team if requested. The audio recording and transcription will be retained for the duration of this research project (end date November 2020) after which it will be erased.

What will happen if I don't carry on with the study?

If you decide to end your involvement in the project before it is completed you will be free to choose whether the diary observations up to that point can be used by the researcher. If you choose to end your involvement during the focus group interview you will be free to choose if you want your responses up to that point to be used.

What will happen to the results of the research study?

The data from your diary and/or focus group interview will form part of this research study which may be published. Quotes may be published directly. You will not be identified in any report/publication without your consent.

Who is organising or sponsoring the research?

This research is funded by MGSS (Malta Government Scholarship Scheme).

Further information and contact details:

The Lead Researcher can be contacted as follows:

May Agius
Speech and Language Therapist
ACTU
Fra Pace Gaetano Forno Road
Hamrun
Malta
may.agius@stu.mmu.ac.uk
+356 25983413

Research Supervisor:
Professor Janice Murray
Department of Health Professions,
Faculty of Health Psychology and Social Care,
Brooks Building,
Manchester Metropolitan University
UK
j.murray@mmu.ac.uk
+44 (0)161 247 2570.

Studies 1, 2 and 4: Parent/carer consent form for child participants- English version

Title of research project: Supporting children with Autistic Spectrum Disorder to ask for things they want using pictures.

Name of researcher:

Participant identification number for this project:

Please initial boxes

☐ 1. I confirm that I have read and understand the information sheet dated _____ explaining the above research project and I have had the opportunity to ask questions about the project.

☐ 2. I understand that my son/daughter's participation is voluntary and that I am free to withdraw him/her at any time without giving any reason, and without there being any negative consequences. Should I wish to withdraw my son/daughter, I can do so by contacting May Agius, Senior Allied Health professional, Speech and Language Therapist, Access to Communication and Technology Unit, 00356-21255876, may.agius.2@ilearn.edu.mt

☐ 3. I understand that all information about my son/daughter will be kept strictly confidential. I understand that his/her name will not be linked with the research materials, and that they will not be identified or identifiable in the report that results from the research.

☐ 4. I understand that a video recording will be made of each session. I understand this recording will be assigned an anonymous code and will be stored as digital media to be kept securely in a password protected folder on a securely stored

portable hard drive when not in use. I also understand that all recordings of my child will be erased from the hard drive after the study is completed and transferred to a CD which will be kept in my child's Access to Communication and Technology Unit (ACTU) file. This file will be stored in a locked filing cabinet. Recordings will be used for analysis for this study only.

☐ 5. I agree to my son/daughter taking part in the above research project.

_____ Name of Child

_____ _____

Name of Parent/Carer Date

Signature

_____ _____

Lead Researcher Date

Signature

_____ _____

Supervisor Date

Signature

To be signed and dated in the presence of the participant

Copies:

Once this has been signed by all parties the participant should receive a copy of the signed and dated participant consent form, the letter/pre-written script/information sheet and any other written information provided to the participants. A copy of the signed and dated consent form should be placed in the project's main record (e.g., a site file), which must be kept in a secure location.

Studies 1, 2 and 4: Parent/carer consent form for child participants- Maltese version

Formula tal-Kunsens mill-ġenituri/Carer

Titlu tal-proġett ta' riċerka: Użu ta' simboli li jgħinu lit-tfal b'Autistic Spectrum Disorder sabiex jistaqsu għall-affarijiet.

Isem tar-riċerkatur:

Numru ta' identifikazzjoni tal-parteċipant għal dan il-proġett:

Jekk jogħġbok ikteb l-inizjali tiegħek fil-kaxex

☐ 1. Nikkonferma li jien qrajt u fhimt il-folja t' informazzjoni datata l-1 ta' Settembru 2016 li tispjega l-proġett ta' riċerka t'hawn fuq u li jiena nista' nistaqsi mistoqsijiet dwar il-proġett.

☐ 2. Jiena nifhem li l-parteċipazzjoni ta' ibni/binti hija waħda fuq bażi volontarja u li jien liberu/a li nirtirah/a fi kwalunkwe ħin mingħajr ma jkun hemm xi konsegwenzi negattivi. Jekk inkun nixtieq nirtira lit-tifel/tifla tiegħi, nista' nagħmel dan billi nikkuntattja lis-Sinj. May Agius, Senior Allied Health professional, Speech and Language Therapist, Access to Communication and Technology Unit, 00356-21255876, may.agius.2@ilearn.edu.mt

☐ 3. Jiena nifhem li l-informazzjoni kollha dwar it-tifel/tifla tiegħi sejra tiżamm strettament kunfidenzjali. Jiena nifhem li ismu/isimha mhux ser ikun relatat mal-materjal ta' riċerka, u li t-tfal mhux ser ikunu identifikati jew jistgħu jiġu identifikati fir-rapport li jirriżulta mir-riċerka.

☐ 4. Jiena nifhem li sejra ssir reġistrazzjoni bil-vidjow ta' kull seduta. Jiena nifhem li din ir-reġistrazzjoni sejra tiġi assenjata kodiċi anonima u sejra tinħażen bħala mezz diġitali li għandu jinżamm b'mod attent f'folder protett b'password fuq hard-drive li tista' tinġarr meta ma jkunx qed jintuża. Nifhem wkoll li r-reġistrazzjoni kollha tat-tifel/tifla tiegħi sejrin jitħassru mill-hard-drive wara li jitlesta l-istudju u dawn sejrin jinżammu fil-fajl tal-Access to communication and Technology Unit (ACTU) tat-tifel/tifla tiegħi. Dan il-fajl sejjer jinżamm f'armarju tal-fajling imsakkar. Ir-reġistrazzjonijiet sejrin jintużaw għall-analażi għal dan l-istudju biss.

☐ 5. Jiena naqbel li t-tifel/tifla tiegħi jieħu/tieħu sehem fil-proġett ta' riċerka msemmi hawn fuq.

_____

Isem tat-Tifel/Tifla

_____ _____

Isem tal-Ġenitur/Carer Data

Firma

_____ _____

Riċerkatur ewlieni Data

Firma

_____ _____

Supervisor Data

Firma

Li għandu jiġi ffirmat u datat fil-preżenza tal-parteċipant

Kopji:

La darba jiġi ffirmat mill-partijiet kollha, il-parteċipant għandu jirċievi kopja tal-formola ta' kunsens tal-parteċipant iffirmata u datata, l-ittra/folja t'informazzjoni u kwalunkwe informazzjoni bil-miktub oħra pprovduta mill-parteċipanti. Kopja tal-formula tal-kunsens iffirmata u datata għandha titpoġġa fir-rekord prinċipali tal-proġett (eż. Fajl tas-sit), li għandha

Study 3: Consent form- Interview

Manchester Metropolitan University

CONSENT FORM

Title of Project: **Clinical decision making for children with autism spectrum disorder who require augmentative and alternative communication**

Name of Researcher: **May Agius**

Please initial all boxes

1. I confirm that I have read and understand the information sheet dated **13/06/2016** (version **1)** for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. ☐

3. I agree to take part in the above study. ☐

Name of Participant	Date	Signature
Name of Person taking consent.	Date	Signature

Consent form date of issue: **13/06/2017**
Consent form version number: **1**

Study 4: Consent form- Focus group

]

CONSENT FORM

Title of Project: **Clinical decision making for children with autism spectrum disorder who require augmentative and alternative communication**

Name of Researcher: **May Agius**

Please initial all boxes

1. I confirm that I have read and understand the information sheet dated **23/10/2017** for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily. ☐

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. ☐

3. I give consent to be audio recorded during the focus group ☐

4. I will allow the researcher to use quotes from the recording when writing up the research. ☐

5. I agree to take part in the above study. ☐

Name of Participant	Date	Signature
Name of Person taking consent.	Date	Signature

Consent form date of issue: **13/06/2017**
Consent form version number: **1**

Page 1 of 1

Appendix 3

Studies 1, 2 and 4: Indirect Reinforcer Assessment Interview Protocol

(Adapted from Green, Sigafoos, Didden, O'Reilly, Lancioni, Ollington & Payne, (2008))

Child's Name: _____ Date of Interview: _____

Person interviewed: _____ Interviewer: _____

Description and Purpose

The purpose of this interview is to identify food/drinks, leisure items and activities that are highly preferred by your child. I will ask you 10 questions about various things that your child might like or prefer. For each question, please try to think of at least 3 things that you think your child really likes. In some cases, we may ask a follow up question to clarify how the child uses the particular item e.g., what does she do when she plays with the mirror?

Questions

1. Some children really enjoy looking at things such as a mirror, bright lights, shiny objects, spinning objects, TV etc. What are the things your child most likes to look at?
2. Some children really enjoy different sounds such as listening to music, car sounds, whistles, beeps, sirens, clapping, people singing etc. What are the things your child most likes to listen to?
3. Some children really enjoy different smells such as perfumes, flowers, coffee, pine trees etc. What are the things your child most likes to smell?
4. Some children really enjoy foods and drinks such as ice cream, juice, pizza, biscuits, crackers etc. What are the things your child most likes to eat and drink?

5. Some children really enjoy physical play or movement such as being tickled, wrestling, running, dancing, swinging, being pulled on a scooter board etc. What activities like this does your child most enjoy?
6. Some children really enjoy touching things of different temperatures, cold things like an ice pack, or warm things like a mug of tea or coffee. What activities like this does your child enjoy?
7. Some children really enjoy feeling different sensations such as splashing water in the sink, feeling vibration on the skin or the feeling of air blowing on the face from a fan. What activities like this does your child most enjoy?
8. Some children really enjoy It when others give them attention such as a hug, a pat on the back, receiving applause, being told they did a 'good job' etc. What forms of attention does your child enjoy?
9. Some children really enjoy certain objects such as puzzles, toy cars, balloons, comic books, torches, bubbles, etc. What are some of your child's favourite toys or objects?
10. What are some other activities or items that your child enjoys?

Data Analysis and Summary

After completing the survey, list the top 8 food/drinks, and the top 8 toy items. For this list, indicate items or stimuli that could be presented to the child in intervention sessions at the Access to Communication and Technology Unit (ACTU), e.g., a toy could be presented but it would not be practical to take the child horse riding.

A. The top 4 food/drinks are:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

B. The top 4 toys are:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

Appendix 4

Studies 1, 2 and 4: Data sheets

Trial data sheets for Studies 1, 2 and 4: Baseline/Follow up Sessions

Name of participant_____Date of session _____

Session no _____

Clinicians present _____ Observer present _____

Trial	Participant behaviour	Object requested
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

21		
22		
23		
24		
25		
26		
27		
28		
29		
30		

Notes:

Summary

Total number of correct responses (VOCA unprompted requests) _____

Total number of incorrect and unprompted responses _____

Percentage of independent requesting _____

Percentage of overall procedural fidelity_____

Trial data sheets for Studies 1 and 2: Intervention Sessions

Name of participant_____Date of session _____

Visual display: Grid VSD Session no _____

Clinicians present _____ Observer present _____

Trial	Participant behaviour	Pick up	Reach	Touch visual to emit voice output	Visual
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					

22					
23					
24					
25					
26					
27					
28					
29					
30					

Notes:

Codes for Pick Up, Reach and Touch visual to emit voice output:

+: independent

FP: full physical prompt

PP: partial physical prompt

Summary

Total number of correct responses _____

Total number of incorrect and promoted responses _____

Percentage of independent requesting _____

Percentage of overall procedural fidelity_____

Trial data sheets for Study 4: Intervention Sessions

Name of participant_____Date of session _____

Display: Grid layout Session no

_____

Clinicians present _____ Observer present _____

Trial	Participant behaviour	Pick up	Reach	Touch visual to emit voice output	Visual
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

21					
22					
23					
24					
25					
26					
27					
28					
29					
30					

Notes:

Codes for Pick Up, Reach and Touch visual to emit voice output:

+: independent

FP: full physical prompt

PP: partial physical prompt

Summary

Total number of correct responses _____

Total number of incorrect and promoted responses _____

Percentage of independent requesting _____

Percentage of overall procedural fidelity_____

Codes for Participant Behaviour in the intervention phase: Studies 1, 2 and 4

1. Correct VOCA: independently activates the visual on the VOCA, no visual or gestural prompts used

2. Incorrect VOCA 1: child independently activates a visual on the VOCA to emit voice output. Child expresses displeasure when given the corresponding reinforcer.

3. Incorrect VOCA 2: child independently activates a visual on the VOCA to emit voice output. Correspondence check indicates an error.

4. Prompted VOCA: Child requires physical prompts to pick up, reach and/or touch the visual to emit voice output

5. Verbal communicative act: child uses a word or makes a word approximation

Appendix 5

Studies 1, 2 and 4: Child participant analyses

Study 1

Within Condition Analysis: Nathan

1. Condition sequence	Baseline: A	Intervention: B VSD	Intervention: C Grid display	Return to baseline: D VSD.	Return to baseline: E Grid display
2. Condition length in sessions	3	6	6	2	2
3. Level	-	-	-	-	-
3.1 median	0	1.95	2.6	n/a	n/a
3.2 mean	0	12.5	16.1	77.1	85.7
3.3 range	0-0	0-50	0-60	86.7-100	71.4-87.5
3.4-3.6 stability envelope (80/25= .25)	0x.25= 0 3/3x100=100 of data points fall in the stability envelope Stable	1.95x.25=.49 1.46-2.44 range of stability envelope 0/6x100= 0 Variable	2.6x.25=.65 1.95-3.25 range of stability envelope 0/6x100=0 Variable	Use same as condition B 86.7+100/2 (+/- .49) = 92.9-93.9 0/2x100=0 Variable	Use same as condition C 71.3+87.5/2 (+/- .65) 78.9-80.2 0/2x100=0 Variable
4. Level change					
4.1 relative change	0-0=0	20.8-0=+20.8 Improving	31.6-0=+31.6 Improving	Due to lack of data points cannot calculate 2 medians but appears to be improving	Due to lack of data points cannot calculate 2 medians but appears to be deteriorating
4.2 absolute change	0-0=0 Zero-celarating	50-0= +50 Improving but delayed	31.6-0=+31.6 Improving but delayed	100-86.7=+13.3 Improving	71.4-87.5= -16.1 Deteriorating
5. Trend					
5.1 direction	Zero-celarating	Delayed then accelerating	Delayed then accelerating	Accelerating	Decelerating
5.2 stability	Stable	Variable	Variable	Stable but only 2 points	Stable but only 2 points

5.3 multiple paths within trend	No	Yes:2	Yes:2	No	No

Study 1

Between Conditions Analysis: Nathan

Condition comparison	B/A VSD/baseline	C/A Grid/baseline	D/B VSD final probe/VSD	E/C Grid final probe/grid
1. Number variables changed	1. Prompting procedure instigated with VSD	1. Prompting procedure instigated with grid display	1. Prompting procedure stopped	1. Prompting procedure stopped
2. Change in trend				
2.1 direction change	Zero-celerating to delayed accelerating	Zero-celerating to delayed accelerating	Accelerating to accelerating	Accelerating to decelerating
2.2 effect	Positive	Positive	Positive	Negative
2.3 stability change	Variable/stable	Variable/stable	Variable/variable	Variable/variable
3. Change in level				
3.1 relative change	0-0 =0 No change	0-0 =0 No change	Cannot calculate, no median value for VSD return to baseline	Cannot calculate, no median value for grid return to baseline
3.2 absolute change	0-0 =0 No change	0-0 =0 No change	66.7-50 =+16.7 Improving	100-31.6 =+68.4 Improving
3.3 median change	1.95-0 =+1.95 Improving	2.6-0 =+2.6 Improving	Cannot calculate, no median value for VSD return to baseline	Cannot calculate, no median value for grid return to baseline
3.4 mean change	12.55-0 =+12.55 Improving	16.1-0 =+16.1 Improving	77.1-12.55 =64.6 Improving	88.7-16.1 =72.6 Improving
4. Data overlap				
4.1 PND	3/6x100 50% B to A Some effect indicated	3/6x100 50% C to A Some effect indicated	N/A	N/A

4.2 POD	3/6x100 50% B to A	3/6x100 50% C to A	N/A	N/A

Study 1

Within Condition Analysis: Simon

1. Condition Sequence	Baseline: A	Intervention: B VSD	Intervention: C Grid display	Return to baseline: D VSD.	Return to baseline: E Grid display
2. Condition length In sessions	3	6	6	2	2
3. Level	-	-	-	-	-
3.1 median	0	85.4	88.6	96	92.9
3.2 mean	0	67.9	88.9	95.3	93.9
3.3 range	0-0	17.9-100	75-100	90-100	88.9-100
3.4-3.6 stability envelope (80/25= .25)	0x.25= 0 3/3x100=100 of data points fall in the stability envelope Stable	85.4x.25=21.4 64-106.8 range of stability envelope 4/6x100= 66.7 Variable	88.6x.25= 22.2 66.4-110.8 Range of stability envelope 6/6 =100 Stable	Use same as condition B 74.6-116.4 3/3= 100% Stable	Use same as condition C 66.7-115.1 3/3=100% Stable
4. Level Change					
4.1 relative Change	0-0=0	80.7-28=+52.7 Improving	93.3-88.3=-5 Deteriorating	Due to lack of data points cannot calculate 2 medians but appears to be stable	Due to lack of data points cannot calculate 2 medians but appears to be stable
4.2 absolute Change	0-0=0 Zero-celarating	100-17.9= +82.1 Improving	100-75=+25 Improving	96-100=-4 Deteriorating	92.9-88.9=+4 Improving
5. Trend					
5.1 direction	Zero-celarating	Immediately Accelerating	Accelerating	Slightly accelerating	Slightly decelerating still within criterion levels
5.2 stability	Stable	Stable, all 6 data points fall in stability envelope, questionable	Stable, all 6 data points fall in stability envelope,	Stable	Stable

5.3 multiple paths within trend	No	No	questionable Yes Accelerating decelerating	No	No

Study 1

Between Conditions Analysis: Simon

Condition Comparison	B/A VSD/baseline	C/A Grid/baseline	D/B VSD final probe/VSD	E/C Grid final probe/grid
1. Number variables changed	1. Prompting procedure instigated with VSD	1. Prompting procedure instigated with grid display	1. Prompting procedure stopped	1. Prompting procedure stopped
2. Change in trend				
2.1 direction Change	Zero-celerating to accelerating	Zero-celerating to accelerating	Accelerating to zero-celerating	Accelerating to zero-celerating
2.2 effect	Positive	Positive	neutral	neutral
2.3 stability Change	Stable/stable	Stable/stable	Stable/stable	Stable/stable
3. Change in level				
3.1 relative Change	28-0 =+28 Improving	93.3-0 =+93.3 Improving	96-28 =+68 Improving	92.9-86 =+4.9 Improving
3.2 absolute Change	17.9-0 =+17.9 Improving	75-0 =+75 Improving	100-90.5 =+9.5 Improving	88.9-88.9 =0 Zero-celerating
3.3 median Change	85.4-0 =+85.4 Improving	88.6-0 =+88.6 Improving	96-85.4 =+10.6 Improving	92.9-88.6 =+4.3 Improving
3.4 mean Change	67.9-0 =+67.9 Improving	88.9-0 =+88.9 Improving	95.3-67.9 =+27.4 Improving	93.9-88.9 =+5.3 improving
4. Data Overlap				
4.1 PND	6/6 x100= 100% B to A Very effective treatment	6/6x100= 100% C to A Very effective treatment	N/A	N/A
4.2 POD	0/6x100= 0% B to A	0/6x100= 0% C to A	N/A	N/A

Study 1

Within Condition Analysis: Jake

1. Condition sequence	Baseline: A	Intervention: B VSD	Intervention: C Grid display	Return to baseline: D VSD.	Return to baseline: E Grid display
2. Condition length In sessions	3	6	6	3	3
3. Level	-	-	-	-	-
3.1 median	0	95.9	93	100	95.5
3.2 mean	0	93.1	86.1	99.1	96.7
3.3 range	0-0	85.1-98.5	51.1-95.9	97.3-100	94.6-100
3.4-3.6 stability envelope (80/25=.25)	0x.25= 0 3/3x100=100 of data points fall in the stability envelope Stable	95.9x.25=24 Range is 71.9-120 6/6 data points fall in range Stable	93x.25=23.3 Range is 69.7-116.3 6/6 data points fall in range Stable	100+/-24= 76-124 3/3= 100% Stable	95.5+/-23.3= 72.2-118.8 3/3= 100% Stable
4. Level Change					
4.1 relative change	0-0=0	98.5-85.1=+13.4 Improving	95.9-87.8=-8.1 deteriorating	100-97.3=+2.7 Improving	100-94.6=+5.4 Improving
4.2 absolute change	0-0=0 Zero-celarating	98.2-85.1=+13.1 Improving	93-51.1=+41.9 Improving	100-98.2=+1.8 Improving	95.5-93=+2.5 Improving
5. Trend					
5.1 direction	Zero-celarating	Accelerating	Deteriorating but all points within criterion after first point	Accelerating	Accelerating
5.2 stability	Stable	Stable	Stable	Stable	Stable
5.3 multiple paths within trend	No	No	No	No	No

Study 1

Between Conditions Analysis: Jake

Condition comparison	B/A VSD/baseline	C/A Grid/baseline	D/B VSD final probe/VSD	E/C Grid final probe/grid
1. Number variables changed	1. Prompting procedure instigated with VSD	1. Prompting procedure instigated with grid display	1. Prompting procedure stopped	1. Prompting procedure stopped
2. Change in trend				
2.1 direction change	Zero-celerating to accelerating	Zero-celerating to accelerating	Accelerating to accelerating	Accelerating to accelerating
2.2 effect	Positive	Positive	Positive	Positive
2.3 stability change	Stable/stable	Stable/stable	Stable/stable	Stable/stable
3. Change in level				
3.1 relative change	85.1-0 =+85.1 Improving	95.9-0 =+95.9 Improving	100-85.1 =+14.9 Improving	95.5-87.8 =+7.1 Improving
3.2 absolute change	85.1-0 =+85.1 Improving Steeper initial trend	51.1-0 =+51.1 Improving	100-98.2 =+1.8 Improving	95.5-93 =+2.5 Improving
3.3 median change	95.9-0 =+95.9 Improving	93-0 =+93 Improving	100-95.9 =+4.1 Improving	95.5-93 =+2.5 Improving
3.4 mean change	93.1-0 =+93.1 Improving	86.1-0 =+86.1 Improving	99.1-93.1 =+6 Improving	96.7-86.1 =+10.6 Improving
4. Data overlap				
4.1 PND	6/6 x100= 100% B to A Very effective treatment	6/6x100= 100% C to A Very effective treatment	N/A	N/A
4.2 POD	0/6x100= 0% B to A	0/6x100= 0% C to A	N/A	N/A

Study 1

Within Condition Analysis: David

1. Condition Sequence	Baseline: A	Intervention: B VSD	Intervention: C Grid display	Return to baseline: D VSD.	Return to baseline: E Grid display
2. Condition length In sessions	3	6	6	2	2
3. Level	-	-	-	-	-
3.1 median	0	46.8	62.8	63.2	71.4
3.2 mean	0	47.2	37.9	65.5	71.4
3.3 range	0-0	19.4-76.5	8.9-55.2	50-83.3	61.5-81.3
3.4-3.6 stability envelope (80/25= .25)	0x.25= 0 3/3x100=100 of data points fall in the stability envelope Stable	46.8x.25=11.7 Range is 35.1 – 48.5 3/6 of data points fall in the stability envelope Variable	62.8x.25=15.7 Range is 47.1-78.5 3/6 of data points fall in the stability envelope Variable	63.2+/-11.7 Range is 51.5-74.9 2/3 of data points fall in the stability envelope Variable	71.4+/-15.7 Range is 55.7-87.1 3/3 of data points fall in the stability envelope Stable
4. Level Change					
4.1 relative Change	0-0=0	65.9-19.4= +46.5 Improving	55.2-8.9= +46.3 Improving	83.3-50= +33.3 Improving	81.3-61.5= +19.8 Improving
4.2 absolute Change	0-0=0 Zero-celarating	65.0-27.8= +37.2 Improving	51.9-8.9= +43 Improving	83.3-65.9= +17.4 Improving	81.3-55.2= +26.1 Improving
5. Trend					
5.1 direction	Zero-celarating	Accelerating	Accelerating	Accelerating	Accelerating
5.2 stability	Stable	Variable	Variable	Variable	Variable
5.3 multiple paths within trend	No	No	No	No	No

Study 1

Between Conditions Analysis: David

Condition Comparison	B/A VSD/baseline	C/A Grid/baseline	D/B VSD final probe/VSD	E/C Grid final probe/grid
1. Number variables changed	1. Prompting procedure instigated with VSD	1. Prompting procedure instigated with grid display	1. Prompting procedure stopped	1. Prompting procedure stopped
2. Change in trend				
2.1 direction Change	Zero-celerating to accelerating	Zero-celerating to accelerating	Accelerating	Accelerating
2.2 effect	Positive	Positive	Positive	Positive
2.3 stability Change	Variable/Stable	Variable/Stable	Variable/variable	Variable/Stable
3. Change in level				
3.1 relative Change	27.8-0= +27.8 Improving	23.3-0= +23.3 Improving	50-76.5= -26.5 Deteriorating	61.5-51.9= +9.6 Improving
3.2 absolute Change	19.4-0= +19.4 Improving	8.9-0= +8.9 Improving	63.2-65.9= -2.7 Deteriorating	71.4-55.2= +16.2 Improving
3.3 median Change	46.8-0= +46.8 Improving	62.8-0= +62.8 Improving	63.2-46.8= +16.4 Improving	71.4-62.8= +8.6 Improving
3.4 mean Change	47.2-0= +47.2 Improving	37.9-0 +37.9 Improving	65.5-47.2= +18.3 Improving	71.4-37.9= +33.5 Improving
4. Data Overlap				
4.1 PND	6/6 x100= 100% B to A Very effective treatment	6/6x100= 100% C to A Very effective treatment	N/A	N/A
4.2 POD	0/6x100= 0% B to A	0/6x100= 0% C to A	N/A	N/A

Study 2

Within Condition Analysis: Mark

1. Condition sequence	Baseline: A VSD/Grid display	Intervention: B VSD	Intervention: C Grid display	Post-intervention: D VSD	Post-intervention: E Grid display
2. Condition length In sessions	3	8	8	3	3
3. Level	-	-	-	-	-
3.1 median	0	68.7	78.7	77.8	94.1
3.2 mean	0	59.8	66.9	54.8	93.3
3.3 range	0-0	25-85.7	28.2-96	0-86.7	85.7-100
3.4-3.6 stability envelope (80/25=.25)	0 x.25= 0 0-0 Range of stability envelope 3/3x100= 100% of data points fall in the stability envelope Stable	68.7 x .25= 17.2 51.5-85.9 range of stability envelope 3/7x100= 42.3% Variable	78.7 x .25=19.7 59-98.4 range of stability envelope 5/7x100= 71.4% Variable	77.8 x .25=19.5 58.5-97.5 Range of stability envelope 2/3x100= 66.7% Variable	94.1 x .25=23.5 70.5-100 Range of stability envelope 3/3x100= 100% Stable
4. Level change					
4.1 relative change	0-0=0	26.1-0=+26.1 Improving	43.3-0=+43.3 Improving	Due to lack of data points cannot calculate 2 medians but appears to be improving	Due to lack of data points cannot calculate 2 medians but appears to be improving
4.2 absolute change	0-0=0 Zero-celarating	87.5-25=+62.5 Improving	96-28.2=+67.8 Improving	86.7-0=+86.7 Improving	100-85.7=+14.3 Improving
5. Trend					
5.1 direction	Zero-celarating	Accelerating	Accelerating	Accelerating	Decelerating
5.2 stability	Stable	Variable: 6/8 data points fall within	Variable: 5/8 data points fall within	N/A	N/A

		the stability envelope	the stability envelop		
5.3 multiple paths within trend	No	No	No	No	No

Study 2

Between Condition Analysis: Mark

Condition comparison	B/A VSD intervention/ baseline	C/A Grid intervention/ baseline	D/B VSD Post-intervention/VSD intervention	E/C Grid Post-intervention/grid intervention
1. Number variables changed	1. Prompting procedure instigated with VSD	1. Prompting procedure instigated with grid display	1. Prompting procedure stopped	1. Prompting procedure stopped
2. Change in trend				
2.1 direction change	Zero-celerating to accelerating	Zero-celerating to accelerating	Accelerating to accelerating	Accelerating to accelerating
2.2 effect	Positive	Positive	Positive	Positive
2.3 stability change	Variable/stable	Variable/stable	Variable/variable	Stable/variable
3. Change in level				
3.1 relative change	34.1-0 =+34.1 Improving	45-0 =+45 Improving	80.9-77.8= +3.1 Improving	86.1-85.7= +0.4 Improving
3.2 absolute change	25-0=+25 Improving	28.2-0=+28.2 Improving	0-85.7 =-85.7 Deteriorating	85.7-96 =-10.3 Deteriorating
3.3 median change	68.7-0 =+68.7 Improving	78.7-0 =+78.7 Improving	77.8-68.7 =+9.1 Improving	94.1-78.7 =+15.4 Improving
3.4 mean change	59.8-0 =+59.8 Improving	66.9-0 =+66.9 Improving	54.8-59.8 =-5 Improving	93.3-66.9 =+26.4 Improving
4. Data overlap				
4.1 PND	8/8x100 =100% B to A Very effective treatment	8/8x100 =100% C to A Very effective treatment	N/A	N/A
4.2 POD	0/8x100 =0% B to A	0/8x100 =0% C to A	N/A	N/A

Study 2

Within Condition Analysis: Zak

1. Condition sequence	Baseline: A VSD/Grid display	Intervention: B VSD	Intervention: C Grid display	Post-intervention D VSD.	Post-intervention: E Grid display
2. Condition length In sessions	4	9	9	3	3
3. Level	-	-	-	-	-
3.1 median	0	61.1	44.7	93.3	92.3
3.2 mean	0	65.0	43.7	88.2	91.1
3.3 range	0-0	39-89.3	17-61.4	76.9-94.4	87.5-93.6
3.4-3.6 stability envelope (80/25= .25)	0x.25= 0 3/3x100=100 of data points fall in the stability envelope Stable	61.1x.25=15.3 42.8-73.4 range of stability envelope 4x100= 44.4% Variable	44.7x.25=11.2 33.5-55.9 range of stability envelope 7/9x100=77.8% Variable	Use same as condition B 70.6-100 3/3x100=100% Stable	Use same as condition C 77.6-100 3/3x100= 100% Stable
4. Level change					
4.1 relative change	0-0=0	80-50.2=+29.8 Improving	52.5-47.2=+5.3 Improving	Due to lack of data points cannot calculate 2 medians	Due to lack of data points cannot calculate 2 medians
4.2 absolute change	0-0=0 Zero-celarating	89.3-39=+50.3 Improving	61.4-17=+44.4 Improving	94.4-76.9=-17.5 Deteriorating	92.3-87.5=+4.8 Improving
5. Trend					
5.1 direction	Zero-celarating	Accelerating	Decelerating	Decelerating	Accelerating
5.2 stability	Stable	Variable	Variable	N/A	N/A

5.3 multiple paths within trend	No	Yes:3	Yes:3	No	No

Study 2

Between Conditions Analysis: Zak

Condition comparison	B/A VSD/baseline	C/A Grid/baseline	D/B VSD final probe/VSD	E/C Grid final probe/grid
1. Number variables changed	1. Prompting procedure instigated with VSD	1. Prompting procedure instigated with grid display	1. Prompting procedure stopped	1. Prompting procedure stopped
2. Change in trend				
2.1 direction change	Zero-celerating to accelerating	Zero-celerating to decelerating	Accelerating to decelerating	Decelerating to accelerating
2.2 effect	Positive	Positive	Negative	Positive
2.3 stability change	Variable/stable	Variable/stable	Stable/variable	Stable/variable
3. Change in level				
3.1 relative change	50.2-0 =+50.2 Improving	37.2-0 =+37.2 Improving	94.4-80 =+14.4 Improving	92.3-52.5 =+39.8 Improving
3.2 absolute change	43.2-0 =+43.2 Improving	17-0 =+17 Improving	94.4-89.3 =+5.1 Improving	87.5-47.5 =+40 Improving
3.3 median change	61.1-0 =+61.1 Improving	44.7-0 =+44.7 Improving	94.4-61.1 =+33.3 Improving	92.3-44.7 =+47.6 Improving
3.4 mean change	65-0 =+65 Improving	43.7-0 =+43.7 Improving	88.2-65 =+23.2 Improving	91.1-43.7 =+47.4 Improving
4. Data overlap				
4.1 PND	9/9x100 =100% B to A Very effective treatment	9/9x100 =100% C to A Very effective treatment	N/A	N/A
4.2 POD	0/9x100 =0% B to A	0/9x100 =0% C to A	N/A	N/A

Study 2

Within Condition Analysis: Sam

1. Condition sequence	Baseline: A VSD & Grid display conditions	Intervention: B VSD	Intervention: C Grid display	Return to baseline: D VSD.	Return to baseline: E Grid display
2. Condition length In sessions	5	4	4	3	3
3. Level	-	-	-	-	-
3.1 median	0	67.7	79.1	84.2	78.6
3.2 mean	0	60.0	62.0	85.1	69.5
3.3 range	0-0	0-85.3	4.6-85.4	76.9-94.1	50-80
3.4-3.6 stability envelope (80/25= .25)	0x.25= 0 3/3x100=100 of data points fall in the stability envelope Stable	67.7x.25=16.9 50.8-84.6 range of stability envelope 1/4x100= 25% Variable	79.1x.25=19.8 53.3-98.9 range of stability envelope 3/4x100= 75% Variable	Use same as condition B 84.2+100/2 (+/- 16.9) = 67.3-101.1 3/3x100= 100% Stable	Use same as condition C 78.6+100/2 (+/- 19.8) 58.8-98.4 3/3x100= 100% Stable
4. Level change					
4.1 relative change	0-0=0	87-25= +62 Improving	85-39.1= +45.9 Improving	Due to lack of data points cannot calculate 2 medians	Due to lack of data points cannot calculate 2 medians
4.2 absolute change	0-0=0 Zero-celarating	88.6-0= +88.6 Improving	85.4-4.6=+80.8 Improving	94.1-84.2=+9.9 Improving	78.6-50=+28.6 Improving
5. Trend					
5.1 direction	Zero-celarating	Delayed accelerating	Accelerating	Accelerating	Decelerating
5.2 stability	Stable	3/4x100=75% Variable	3/4x100=75% Variable	N/A	N/A

5.3 multiple paths within trend	No	No	No	No	No

Study 2

Between Conditions Analysis: Sam

Condition comparison	B/A VSD/baseline	C/A Grid/baseline	D/B VSD final probe/VSD	E/C Grid final probe/grid
1. Number variables changed	1. Prompting procedure instigated with VSD	1. Prompting procedure instigated with grid display	1. Prompting procedure stopped	1. Prompting procedure stopped
2. Change in trend				
2.1 direction change	Zero-celerating to delayed accelerating	Zero-celerating to accelerating	Delayed accelerating to accelerating	Accelerating to decelerating
2.2 effect	Positive	Positive	Positive	Negative
2.3 stability change	Variable/stable	Variable/stable	Stable/variable	Stable/variable
3. Change in level				
3.1 relative change	25-0 =+25 Improving	39.1-0 =+39.1 Improving	84.2-87 =-2.8 Deteriorating	78.6-85 =-6.4 Deteriorating
3.2 absolute change	0-0 =0 No change	4.6-0 =0 Improving	84.2-85.3 =-1.1 Deteriorating	50-85.4 =-35.4 Deteriorating
3.3 median change	67.7-0 =+67.7 Improving	79.1-0 =+79.1 Improving	84.2-67.7 =+16.5 Improving	78.6-79.1 =-0.5 Deteriorating
3.4 mean change	60-0 =+60 Improving	62-0 =+62 Improving	85.1-60 =+25.1 Improving	69.5-62 =+7.5 Improving
4. Data overlap				
4.1 PND	3/4x100 =75% B to A Fairly effective treatment	4/4x100 =100% C to A Very effective treatment	N/A	N/A
4.2 POD	1/4x100 =25% B to A	0/4x100 =0% C to A	N/A	N/A

Study 2

Within Condition Analysis: Andy

1. Condition sequence	Baseline: A VSD & Grid display conditions	Intervention: B VSD	Intervention: C Grid display	Return to baseline: D VSD.	Return to baseline: E Grid display
2. Condition length In sessions	6	8	8	3	3
3. Level	-	-	-	-	-
3.1 median	0	51.9	65.1	82.4	80
3.2 mean	0	41.1	48.1	87	54.3
3.3 range	0-0	0-91.3	9.7-97.9	82.4-94.1	69.2-85.7
3.4-3.6 stability envelope (80/25= .25)	0x.25= 0 3/3x100=100 of data points fall in the stability envelope Stable	51.9x.25=13.0 38.9-65 range of stability envelope 4/8x100= 50% Variable	65.1x.25=16.3 48.8-81.4 range of stability envelope 4/6x100= 50% Variable	Use same as condition B 82.4 (+/- 13.0) = 69.4-95.4 3/3x100= 100% Stable	Use same as condition C 80 (+/- 16.3) 63.7-96.3 3/3x100= 100% Stable
4. Level change					
4.1 relative change	0-0=0	69.6-19.7=+49.9 Improving	73.4-36.1=+37.3 Improving	Due to lack of data points cannot calculate 2 medians	Due to lack of data points cannot calculate 2 medians
4.2 absolute change	0-0=0 Zero-celarating	91.3-0= +91.3 Improving but delayed	97.9-9.7=+88.2 Improving	84.6-80=+4.6 Improving	80-85.7=-5.7 Deteriorating
5. Trend					
5.1 direction	Zero-celarating	Delayed accelerating	Accelerating	Accelerating	Decelerating
5.2 stability	Stable	5/8x 100=62.5% Variable	6/8x100= 75% Variable	N/A	N/A

5.3 multiple paths within trend	No	Yes:3	Yes:3	No	No

Study 2

Between Conditions Analysis: Andy

Condition comparison	B/A VSD/baseline	C/A Grid/baseline	D/B VSD final probe/VSD	E/C Grid final probe/grid
1. Number variables changed	1. Prompting procedure instigated with VSD	1. Prompting procedure instigated with grid display	1. Prompting procedure stopped	1. Prompting procedure stopped
2. Change in trend				
2.1 direction change	Zero-celerating to delayed accelerating	Zero-celerating to accelerating	Delayed accelerating to accelerating	Accelerating to decelerating
2.2 effect	Positive	Positive	Positive	Negative
2.3 stability change	Variable/stable	Variable/stable	Stable/variable	Stable/variable
3. Change in level				
3.1 relative change	19.7-0 =+19.7 Improving	36.1-0 =+36.1 Improving	82.4-69.6 =+12.8 Improving	80-73.4 =+6.6 Improving
3.2 absolute change	0-0 =0 No change	9.7-0 =+9.7 Improving	82.4-81.6 =+0.8 Improving	85.7-80 =+5.7 Improving
3.3 median change	51.9-0 =+51.9 Improving	65.1-0 =+65.1 Improving	82.4-65.1 =+17.3 Improving	80-65.1 =+14.9 Improving
3.4 mean change	41.1-0 =+41.1 Improving	48.1-0 =+48.1 Improving	87-41.1 =+45.9 Improving	54.3-48.1 =+6.2 Improving
4. Data overlap				
4.1 PND	6/8x100 =75% B to A Fairly effective treatment	8/8x100 100% C to A Very effective treatment	N/A	N/A
4.2 POD	2/8x100 =25% B to A	0/8x100 =0% C to A	N/A	N/A

Study 4

Within Condition Analysis: Noah

1. Condition Sequence	Baseline probe condition: A	Intervention condition: B	Post-intervention condition: C
2. Condition length In sessions	3	8	3
3. Level			
3.1 median	0	61.3	83.3
3.2 mean	0	49.4	81.7
3.3 range	0-0	0-90.5	71.4-90.5
3.4-3.6 stability envelope (80/25=.25)	0x.25= 0 3/3x100=100 of data points fall in the stability envelope Stable	61.3x.25=15.3 Range is 46-76.6 3/6 of data points fall in the stability envelope Variable	83.3 +/- 15.3 Range is 68-98.6 3/3 of data points fall in the stability envelope Stable
4. Level Change			
4.1 relative Change	0-0=0	79-11.9= +67.1 Improving	90.5-71.4= +19.8 Improving
4.2 absolute Change	0-0=0 Zero-celarating	90.5-0= +90.5 Improving	90.5-71.4= +19.8 Improving
5. Trend			
5.1 direction	Zero-celarating	Accelerating	Accelerating
5.2 stability	Stable	Variable	Stable
5.3 multiple paths within trend	No	No	No

Study 4

Between Conditions Analysis: Noah

Condition Comparison	B/A Intervention/baseline probe	C/B Post-intervention/intervention
1. Number variables changed	1. Prompting procedure instigated	1. Prompting procedure stopped
2. Change in trend		
2.1 direction Change	Zero-celerating to accelerating-improving	Accelerating
2.2 effect	Positive	Positive
2.3 stability Change	Variable to stable	Stable to variable
3. Change in level		
3.1 relative Change	19.2-0= +19.2 Improving	87.5-89.5= +2 Improving
3.2 absolute Change	0-0= 0 No change	87.5-90.5= -3 Deteriorating
3.3 median Change	61.3-0= +61.3 Improving	83.3-62.8= +20.5 Improving
3.4 mean Change	49.4-0= +49.4 Improving	81.7-49.4= +32.3 Improving
4. Data overlap		
4.1 PND	7/8 x100= 87.5% B to A Effective treatment	N/A
4.2 POD	1/8x100= 12.5% B to A	N/A

Study 4

Within Condition Analysis: James

1. Condition Sequence	Baseline probe condition: A	Intervention: B	Post-intervention condition: C
2. Condition length In sessions	3	6	3
3. Level			
3.1 median	0	73.4	86.7
3.2 mean	0	50.1	85.2
3.3 range	0-0	0-85.7	50-83.3
3.4-3.6 stability envelope (80/25= .25)	0x.25= 0 3/3x100=100 of data points fall in the stability envelope Stable	73.4x.25=18.4 Range is 55 – 91.8 3/6 of data points fall in the stability envelope Variable	86.7+/-18.4 Range is 68.3-105.1 3/3 of data points fall in the stability envelope Stable
4. Level Change			
4.1 relative Change	0-0=0	80—23.5= +56.5 Improving	88.9-86.7= -2.2 Deteriorating
4.2 absolute Change	0-0=0 Zero-celarating	85.7-0= +85.7 Improving	83.9-86.7= -2.2 Deteriorating
5. Trend			
5.1 direction	Zero-celarating	Accelerating	Decelerating
5.2 stability	Stable	Variable	Stable
5.3 multiple paths within trend	No	No	No

Study 4

Between Conditions Analysis: James

Condition Comparison	B/A Intervention/baseline probe	C/B Post-intervention/intervention
1. Number variables changed	1. Prompting procedure instigated	1. Prompting procedure stopped
2. Change in trend		
2.1 direction Change	Zero-celerating to accelerating	Decelerating
2.2 effect	Positive	Negative
2.3 stability Change	Variable/Stable	Stable/Variable
3. Change in level		
3.1 relative Change	23.5-0= +23.5 Improving	88.9-80= +3.2 Improving
3.2 absolute Change	0-0= 0 No change	88.9-85.7= + Improving
3.3 median Change	73.4-0= +73.4 Improving	80-73.4= +6.6 Improving
3.4 mean Change	50.1-0= +50.1 Improving	85.2-50.1= +35.1 Improving
4. Data overlap		
4.1 PND	5/6 x100= 83.3% B to A Effective treatment	N/A
4.2 POD	1/6x100= 16.7% B to A	N/A

Study 4

Within Condition Analysis: Lee

1. Condition Sequence	Baseline probe condition: A	Intervention: B	Post-intervention: C
2. Condition length In sessions	3	7	3
3. Level			
3.1 median	0	21.7	88.9
3.2 mean	0	42.6	88.7
3.3 range	0-0	7.3-83.3	87.5-89.7
3.4-3.6 stability envelope (80/25=.25)	0x.25= 0 3/3x100=100 of data points fall in the stability envelope Stable	46.8x.25=5.4 Range is 41.4 – 52.2 0/7 of data points fall in the stability envelope Variable	88.9+/-5.4 Range is 83.5-94.3 3/3 of data points fall in the stability envelope Stable
4. Level Change			
4.1 relative Change	0-0=0	83.3-7.3= +75.6 Improving	88.9-87.5= +1.4 Improving
4.2 absolute Change	0-0=0 Zero-celarating	83.3-7.3= +81 Improving	88.9-87.5= +1.4 Improving
5. Trend			
5.1 direction	Zero-celarating	Accelerating	Accelerating
5.2 stability	Stable	Variable	Stable
5.3 multiple paths within trend	No	No	No

Study 4

Between Conditions Analysis: Lee

Condition Comparison	B/A intervention/baseline probe	C/B Post-intervention/intervention
1. Number variables changed	1. Prompting procedure	1. Prompting procedure stopped
2. Change in trend		
2.1 direction Change	Zero-celerating to accelerating	Accelerating
2.2 effect	Positive	Positive
2.3 stability change		
3. Change in level	Variable/Stable	Stable/variable
3.1 relative Change	13.3-0= +13.3 Improving	87.5-88.9= -1.4 Deteriorating
3.2 absolute Change	19.4-0= +19.4 Improving	71.4-55.2= +16.2 Improving
3.3 median Change	7.3-0= +7.3 Improving	87.5-83.3= +4.2 Improving
3.4 mean Change	42.6-0= +42.6 Improving	88.7-42.6= +46.1 Improving
4. Data overlap		
4.1 PND	7/7 x100= 100% B to A Very effective treatment	N/A
4.2 POD	0/7x100= 0% B to A	N/A

Study 4

Within Condition Analysis: Max

1. Condition Sequence	Baseline probe condition: A	Intervention: B	Post-intervention: C
2. Condition length In sessions	3	5	3
3. Level			
3.1 median	0	73.3	87.8
3.2 mean	0	68.2	89
3.3 range	0-0	37.3-83	86.2-93
3.4-3.6 stability envelope (80/25= .25)	0x.25= 0 3/3x100=100 of data points fall in the stability envelope Stable	73.3x.25=18.3 Range is 19 – 101.3 5/5 of data points fall in the stability envelope Stable	87.8+/-18.3 Range is 69.5-106.1 3/3 of data points fall in the stability envelope Stable
4. Level Change			
4.1 relative Change	0-0=0	82-52= +30 Improving	87.8-86.2= +1.6 Deteriorating
4.2 absolute Change	0-0=0 Zero-celarating	90.9-37.3= +53.6 Improving	87.8-86.2= +1.6 Deteriorating
5. Trend			
5.1 direction	Zero-celarating	Accelerating	Decelerating
5.2 stability	Stable	Stable	Stable
5.3 multiple paths within trend	No	No	No

Study 4

Between Conditions Analysis: Max

Condition Comparison	B/A intervention/baseline probe	C/B Post-intervention/intervention
1. Number variables changed	1. Prompting procedure	1. Prompting procedure stopped
2. Change in trend		
2.1 direction Change	Zero-celerating to accelerating	Accelerating
2.2 effect	Positive	Positive
2.3 stability change		
3. Change in level	Stable/Stable	Stable/Stable
3.1 relative Change	52-0= +52 Improving	87.8-52= +35.8 Improving
3.2 absolute Change	37.3-0= +37.3 Improving	87.8-80.9= +6.9 Improving
3.3 median Change	73.3-0= +73.3 Improving	87.8-73.3= +14.5 Improving
3.4 mean Change	73.3-0= +73.3 Improving	87.8-73.3= +14.5 Improving
4. Data overlap		
4.1 PND	0/5 x100= 100% B to A Very effective treatment	N/A
4.2 POD	0/6x100= 0% B to A	N/A

Appendix 6
Procedural fidelity sheets

Procedural fidelity sheet for Studies 1 and 2

Date _____

Baseline/intervention/post-intervention

Completed by observer: _____

Before session commences

1) Child shown which reinforcers are available using a visual Y N
2) Child verbally told that he can ask for things when shown the visual Y N

Organization

3) Room is neat and cleared Y N
4) Reinforcers are within view yet out of reach Y N

Session length:

5) Data collected for 20 minutes Y N

All phases of the project for every requesting opportunity

	Trial																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1) iPad is close to the child																					
2) iPad is open on the AAC app																					
3) App open on the correct visual display																					
4) Clinician follows child's lead																					
5) Clinician waits for the child to initiate requesting																					
6) Clinician entices the child to request using desired items																					

Key: (+) = occurrence, (-) = nonoccurence

During intervention phase only for every requesting opportunity

	Trial																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Physical promoter implements most to least prompting hierarchy if child does not use iPad independently																					
2. Physical promoter fades prompts																					
3. Communication partner responds verbally																					
4. Child receives desired item within 1 second																					
5. Correspondence check carried out if child requests a new item																					

6. Error correction procedure utilized if correspondence check indicates non correspondence or child shows displeasure in item received																				
7. Time given to consume snack or play with leisure item																				

Key: (+) = occurrence, (-) = non-occurrence

Procedural fidelity sheet for Study 4: SCED study

Date _____

Baseline/intervention/post-intervention

Completed by observer: _____

Before session commences

1) Child shown which reinforcers are available using a visual Y N
2) Child verbally told that he can ask for things when shown the visual Y N

Organization

3) Room is neat and cleared Y N
4) Reinforcers are within view yet out of reach Y N

Session length:

5) Data collected for 20 minutes Y N

All phases of the project for every requesting opportunity

	Trial																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1) iPad is close to the child																					
2) iPad is open on the AAC app																					
3) Clinician follows child's lead																					
4) Clinician waits for the child to initiate requesting																					
5) Clinician entices the child to request using desired items																					

Key: (+) = occurrence, (-) = non-occurrence

During intervention phase only for every requesting opportunity

	Trial																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1. Physical promoter implements most to least prompting hierarchy if child does not use iPad independently																					
2. Physical promoter fades prompts																					
3. Communication partner responds verbally																					
4. Child receives desired item within 1 second																					
5. Correspondence check carried out if child requests a new item																					

6. Error correction procedure utilized if correspondence check indicates non correspondence or child shows displeasure in item received																					
7. Time given to consume snack or play with leisure item																					

Key: (+) = occurrence, (-) = non-occurrence

Appendix 7

Social Validity questionnaires

Social validity questionnaire: Study 2

Social Validity: Post-intervention Questionnaire: English Version

Parent Rating Form

Questions 1 to 12 based on TREATMENT ACCEPTABILITY RATING FORM. REVISED (TARF-R)
By Thomas Reimers and David Wacker (1988) and Modified by Miriam Boesch and Oliver Wendt (2013)
Further revisions and additional questions by May Agius

Please complete the items listed below. The items should be completed by circling the number (1 to 5) that best indicates how you feel about the intervention strategies (iPad with 2 different visual displays: grid display and visual scene display) conducted with your child during the research study.

1. How clear is your understanding of the intervention strategies implemented with your child?

1	2	3	4	5
Not at all clear		Neutral		Very clear

2. How acceptable do you find the intervention strategies to be regarding your concerns about your child?

1	2	3	4	5
Not at all acceptable		Neutral		Very acceptable

3. How willing are you to use these intervention strategies at your home?

1	2	3	4	5
Not at all willing		Neutral		Very willing

4. To what extent do you think there might be disadvantages in following these intervention strategies?

1	2	3	4	5
Not at all likely		Neutral		Very likely

5. How likely are these intervention strategies to make permanent improvement in your child's communication?

1	2	3	4	5
Unlikely		Neutral		Very likely

6. How much time would be needed each day for you to implement these strategies?

1	2	3	4	5
Little time		Neutral		Much time

7. How confident are you that these strategies will be effective?

1	2	3	4	5
Not at all confident		Neutral		Very confident

8. How disruptive will it be to your home life to implement these intervention strategies?

1	2	3	4	5
Not at all disruptive		Neutral		Very disruptive

9. To what extent are undesirable side-effects likely to result from these intervention strategies?

1	2	3	4	5
No side-effects		Neutral		Many side-effects

10. Have you noticed positive effects on your child's communicative behaviours in any of the following 3 areas?

a) improvements in requesting skills (asking for things)

1	2	3	4	5
No effects at all observed		Somewhat		Many effects

b) better social behaviour interaction with others

1	2	3	4	5
No effects at all observed		Somewhat		Many effects

c) emerging speech

1	2	3	4	5
No effects at all		Somewhat		Many effects observed

Additional Questions:

1. I think my child should continue to learn to communicate with
   ☐ Grid display ☐ Visual Scene Display
   ☐ both displays ☐ none of them

Please state why...

2. What were some benefits of the intervention sessions?

3. Which visual layout (grid or visual scene display) do you think was the most successful for teaching your child to ask for things? Why?

4. Which visual layout (grid or visual scene display) do you think was the least successful for teaching your child to ask for things? Why?

5. Did you notice any changes in the communication of the child? What kind?

Please add anything you would like to say about how your child progressed in the study

Social validity questionnaire: Study 4

Parent form:

Questions 1 to 12 based on TREATMENT ACCEPTABILITY RATING FORM. REVISED (TARF-R)
By Thomas Reimers and David Wacker (1988) and Modified by Miriam Boesch and Oliver Wendt (2013)
Further revisions and additional questions by May Agius

Please complete the items listed below. The items should be completed by circling the number (1 to 5) that best indicates how you feel about the intervention strategies (iPad with 2 different visual displays: grid display and visual scene display) conducted with your child during the research study.

1. How clear is your understanding of the intervention strategies implemented with your child?

1	2	3	4	5
Not at all clear		Neutral		Very clear

2. How acceptable do you find the intervention strategies to be regarding your concerns about your child?

1	2	3	4	5
Not at all acceptable		Neutral		Very

3. How willing are you to use these intervention strategies at your home?

1	2	3	4	5
Not at all willing		Neutral		Very willing

4. To what extent do you think there might be disadvantages in following these intervention strategies?

1	2	3	4	5
Not at all likely		Neutral		Very likely

5. How likely are these intervention strategies to make permanent improvement in your child's communication?

1	2	3	4	5
Unlikely		Neutral		Very likely

6. How much time would be needed each day for you to implement these strategies?

1	2	3	4	5
Little time		Neutral		Much time

7. How confident are you that these strategies will be effective?

1	2	3	4	5
Not at all confident		Neutral		Very confident

8. How disruptive will it be to your home life to implement these intervention strategies?

1	2	3	4	5
Not at all disruptive		Neutral		Very disruptive

9. To what extent are undesirable side-effects likely to result from these intervention strategies?

1	2	3	4	5
No side-effects		Neutral		Many side-effects

10. Have you noticed positive effects on your child's communicative behaviours in any of the following 3 areas?

a) improvements in requesting skills (asking for things)

1	2	3	4	5
No effects at all		Somewhat		Many effects observed

b) better social behaviour interaction with others

1	2	3	4	5
No effects at all		Somewhat		Many effects observed

c) emerging speech

1	2	3	4	5
No effects at all		Somewhat		Many effects observed

Additional Questions:

1. What were some benefits of the intervention sessions?

2. Did you notice any changes in the communication of the child? What kind?

Please add anything you would like to say about how your child progressed in the study

Appendix 8

Study 3: OT topic guide

1. I would like to begin this interview with you telling me about your experience of AAC interventions with children with ASD. What are your experiences of AAC to date?

   Follow up questions:
   - What strategies do you think work or not work when trying to teach children with a diagnosis of ASD to use AAC?
   - Can you tell me more about why you think that those strategies work when teaching children with ASD to use AAC? What about the strategies that are less successful, why is that do you think?

2. We taught children to use 2 different display layouts. What is your opinion of the 2 display layouts?

3. I would like you to think about sensory processing difficulties and learning to use AAC in children with ASD. What is your opinion of the relationship between sensory processing difficulties and children with ASD who are learning to use AAC, if any impact at all?
   Follow up questions:
   - Can you tell me more about that?
   - Could you walk me through that in more detail?
   - Can you give me an example of that?

4. Please, could you describe to me the process of how you typically go about assessing sensory processing difficulties in children with a diagnosis of ASD?
   Follow-up questions:
   - Can you tell me more about that?
   - Could you walk me through that in more detail?

- How does the assessment process relate to the intervention you provide for sensory processing difficulies in children with ASD?

5. I would like to know more about the possible interventions for sensory processing difficulties. Please can you describe in as much detail as possible the kinds of interventions you typically provide for children with ASD and co-existing sensory processing difficulties?

6. How did you decide which interventions to provide for each of the 4 children in the study? Can you give me some examples of these?

7. What happened when you provided sensory based interventions to the 4 children in the last study?

   Follow up questions:
   - Can you tell me more about that? Can you provide more detail about what happened? How did that make you feel?

8. How do you feel about a speech and language therapist implementing sensory based interventions when working with children with ASD who are learning to use AAC?

   Follow-up questions:
   - Can you relate this to the children in the last study?
   - Can you give specific examples?

9. Can you suggest any changes that you would make to the study design if you were to implement sensory based interventions to 4 more children with a coexisting diagnosis of ASD and sensory processing difficulty who are learning to use AAC systems?
   Follow-up questions:

- Please explain why you would make these changes.

10. Can you describe your professional background? How long have you worked as an Occupational Therapist?

11. Is there anything else you expected me to ask you about? Is there anything you would like to add?

Thank you for answering these questions.

Appendix 9

Study 4: Diary Observations Guide

You will be observing therapists providing AAC intervention to a child. Observe the way that the therapists interact with the child. The following is a list of communicative behaviours which can be used to guide your observations:

- The use of gesture and posture
- The use of the face
- The use of touch
- The use of eye behaviour
- The use of vocal cues
- The use of verbal language
- Anything else which you observe which you feel has influenced the interaction between the child and therapist

Appendix 10

Study 4: Focus group interview guide

1. Can you tell me a little about your professional backgrounds?
2. Think back to the last time you were working with a child with ASD, how did you establish a connection with the child?
3. You were asked to observe the interactions between therapists and children, can you tell me about your observations?
4. How did the therapists' nonverbal communication affect the interactions?
5. What did you observe in terms of how the therapists communicated verbally?
6. How did the therapists' interactions differ with the different children?
7. In what way did the therapists adapt when providing their interventions during the sessions?
8. Of all the things we talked about today, what to you was the most important? Why?

Appendix 11

Sensory processing programmes

Sensory Processing Programme: Study 2

Mark

Environmental modifications used in AAC sessions:

Allow alternations between seating and standing

Call child's name before giving instructions

Get face to face

Animation to get attention

Use firm and animated tone of voice

Introducing novel play ideas to get interest and maintain it

Allow stand and move at will

Vestibular activities:

Bouncing on a therapy ball

Sam

Environmental modifications used in AAC sessions:

Structured space with physical boundaries using furniture

Heavy work activities:

Wheelbarrow walk

Bouncing on the gym ball

Stacking books

Weighted vest during session

Pulling resistive thera band

Crawling on hands and knees

Throw and catch heavy ball

Oral motor activities:

Blowing a balloon

Blowing bubbles

Blowing through a straw

Zak

Environmental modifications used in AAC sessions:

Put AAC device in the visual field of the child

Therapist should sit in front of the child

Call child's name before giving instructions

Vestibular activities:

Spin on an office chair

Bouncing on a therapy ball

Heavy work activities:

Wheelbarrow walk

Dog walk

Throwing and catching a ball

Activities in the sensory motor room:

Vestibular activities: run and crash into beanbags

Heavy work activities incorporated in obstacle course

Climb bean bags, propelling scooter board with feet, jump through hoola hoops, push out the gym ball from the tunnel, tummy on the ball and then walk on hands

Andy

Environmental modifications used in AAC sessions:

Put AAC device in the visual field of the child

Therapist should sit in front of the child

Call child's name before giving instructions

Use firm and animated tone of voice

Animated and exaggerated facial expressions

Use tickles to alert

Vestibular activities:

Spin on an office chair

Bouncing on a therapy ball

Rolling in a barrel

Heavy work activities:

Wheelbarrow walk

Dog walk

Throwing and catching a ball

Pulling and pushing activities

Activities in the sensory motor room:

Circular and linear swinging

Roll onto gym ball and then walk on hands

Propelling scooter with legs

Crawling through tunnel and through rollers

Crash and bump into beanbags

Crawling out from under beanbags

Walk on large blocks

Sensory Processing Programmes: Study 4

Max

Environmental modifications used in AAC sessions:

Structured space with physical boundaries using furniture and free of distractions
Dynamic seating
Use of a visual schedule
Sensory breaks given
Allowed movement in between activities e.g., child can get up to take drink or food
Use calm voice when speaking to the child

Noah

Environmental modifications used in AAC sessions:

Allow child to choose where to sit/lay down
Use of a visual schedule
Put AAC device in the visual field of the child
Therapist should position herself in front of the child
Call child's name before giving instructions
Use firm and animated tone of voice
Animated and exaggerated facial expressions

Activities in Sensory Motor room:

Vestibular activities to alert the child – run and crush into beanbags
Heavy work activities incorporated in an obstacle course. Note: first and last activity remained always the same, whilst the middle activities were changed and level of difficulty increased across sessions'
Activities included: climb bean bags, propelling scooter board with feet, jump through hoolahoops, crawl through the tunnel, push out the peanut ball from the tunnel, tummy on the ball and then walk on hands, go through roller, jumping in hoola hoops.

James

Environmental modifications used in AAC sessions:

Put AAC device in the visual field of the child

Therapist should sit in front of the child

Call child's name before giving instructions

Use firm and animated tone of voice

Animated and exaggerated facial expressions

Use joint compressions

Provide pressure when needed

Heavy work activities:

Wheelbarrow walk

Pulling resistive thera band

Activities in Sensory Motor room:

Activities in sensory motor room 10 -15 mins

Vestibular activity: swinging on platform swing linear movement and pushing against large beanbag

Obstacle course to incorporate deep pressure and heavy work activities:

Passing through lycra tunnel and pushing ball out, tummy on ball and walk on hands, passing through roller, running and jump on beanbag.

Ended activity: joint compressions

Lee

Environmental modifications used in AAC sessions:

Structured space with physical boundaries using furniture and free of distractions

Use of a visual schedule

Allowed to stand during activities

Use calm voice when speaking to the child

Activities in Sensory Motor room:

10-15 minutes in sensory motor room

Crash and bump, jumping in hoolahoops, crawling, climbing on beanbags, tummy on scooter board and propel himself using hands, going through tunnel, linear swinging starting fast matching his energy level and then reducing the speed of swinging to get him to the just right level

Therapeutic strategies used in sensory motor room and also during AAC intervention sessions:

Soft and low voice when talking to him, lots of praise, quick reinforcement

Approaching the child from the front or side when talking to him or using physical assistance.

Calming strategies: modelling of deep breathing, to teach Luca how to calm breath – pressure on tummy was applied to guide the breathing, deep pressure applied on the shoulders

Appendix 12

Study 2: Transcript and coding of qualitative responses from Social Validity Questionnaire: Part 2

a) I think my child should continue to learn to communicate with… and why?

Sam's mother: Grid. Squares are clearer, easier to find. Smaller in the scene.

Mark's mother: Both are ok. The grid is clearer.

Zak's mother: Grid. I think the grid was more comfortable. He made less mistakes with the grid. He could use his thumb (on the grid). He made more mistakes with the VSD, pressing cells next to it, he was more precise with the grid.

Andy's mother: Grid. Easier to focus on a grid. I prefer the grid as others are too close, will try to touch one but might hit another

b) What were the benefits of the intervention sessions?

Sam's mother: He was asking for things. He co-operated

Mark's mother: He has a good method of communication now
He is socialising more with different people and immediately relating to others, not just me (mum)

Zak's mother: He is taking more notice of others and playing with them. He used to ignore others but now he will play with others

Andy's mother: He is more persistent, gets angry if not understood. He will try to find a way to tell you what he wants. He is asking for things from others (adults) now. He is experimenting more, exploring everything, playing with children. He is now noticing more things

c) Which visual layout do you think was the most successful and why?

Sam's mother: no difference

Mark's mother: Grid

I think he did better with the grid, when I look at the displays with my eyes I know I would do better with the grid. The VSD confuses me, maybe the red (squares). The colours blend too much

Zak's mother: Grid. The squares are too close together in the picture

Andy's mother: No difference. If he really wants something the display does not matter, he will touch the correct place. I was thinking he would get confused but it really didn't matter

d) *Which visual layout was least successful and why?*

Sam's mother: No difference

Mark's mother: see above

Zak's mother: VSD. The pictures are on top of each other, especially the middle 2

Andy's mother: see above

e) *Did you notice any changes in the communication of your child? What kind?*

Sam's mother: more requesting. More repeating what the therapist said

Mark's mother: Lots of improvement. Could have been ABA and SLT sessions. He is looking more. Waving bye now. He is relating to others more. He is paying attention socially more. Eye contact has improved. He has a good method of communication now

Zak's mother: He improved as he can ask for what he wants. At home he has started bringing me objects, if he wants to go out he grabs my hand and opens the door, for a drink he brings me a bottle. Since the study started he is much less frustrated, he used to whine. He is using gestures more, also to show 'stop' he puts my hand over my mouth

Andy's mother: as above

f) Other comments

Sam's mother: He made good progress. He did well, he was communicating with the therapists. He used the iPad differently to the home tablet. He was deliberate with pointing, was deliberate with asking for what he wanted. At home he is different, he can get what he wants himself, he knows where things are. My fear is that he will mix it all up and try to exit the app

Mark's mother: I think everyone should learn to use a tablet if they cannot speak. Grateful to have a chance for my son to learn to use a tablet to communicate. I understand him but how will he be communicating with other people to school and other people at school. I want him to communicate with others, his teaching assistant

Zak's mother: none

Andy's mother: for a period he was confused and did not want to come or go anywhere but he settled again

Study 2: From codes to subthemes

Codes	*Subthemes identified*
• Display Appearance • Learning to use the VOCA • Visual properties of the display and impact on access	*1. VOCA design features*

• Communicative behaviours
  ○ Requesting
  ○ Verbal
  ○ Gestures
  ○ Using objects
• Social communication
• Behaviour
	2. Impact of VOCA interventions targeting communication

• Use of a tablet • Home communicative environment	*3. Use of mainsteam tablet technology as a VOCA*

Study 2: From subthemes to themes

Subthemes	*Theme*
1. VOCA design features *2. Impact of VOCA interventions targeting communication* 3. *Use of mainstream tablet technology as a VOCA*	Parental perceptions of using a VOCA to support the development of communication skillS

Study 4: From codes to potential subthemes

Codes	*Potential subthemes*

• Communicative behaviours
  ○ Requesting
  ○ Verbal
  ○ Gestures
  ○ Choices
	1. Communication has increased with VOCA intervention
	2. There is increased requesting using gestures with intervention
	3. There is increased requesting using the VOCA with intervention
	4. Learning to use the VOCA had a positive impact on non-verbal communication including pointing and eye contact
	5. Choice making skills have emerged

• Comprehension	6. There is improved comprehension
• Attention	7. Attention skills have improved
• Social communication	8. Learning to use a VOCA had a positive impact as the child is now showing greater interest in other people 9. Play has improved since VOCA intervention began
• Speech	10. Learning to use the VOCA has resulted in more speech sounds 11. Imitation of speech is emerging
• Behaviour	12. Learning to use the VOCA had a positive impact on the child's behaviour 13. My child is less frustrated when he uses the VOCA
• Motor skills	14. There was improvement in my child's motor skills 15. Movement supports learning
• Impact of communication difficulty	16. Difficulty in communicating can result in challenging behaviour

• Use of a tablet	17. Learning to request with a VOCA is not necessarily social interaction
• Clinician's behaviours	18. The clinicians were persistent
• Home communicative environment	19. Changes to the home environment are needed to teach VOCA use
• Parental perceptions of their children	20. My child can learn
• Implementation of VOCA interventions	21. Parents should implement the AAC interventions 22. AAC interventions need to be implemented in all environments
• Fears about AAC systems	23. Use of an AAC system could have a negative impact on speech development 24. It could be challenging to teach the AAC system 25. The VOCA could end up being used for play
• Acceptance	26. My child needs a VOCA
• Aspirations	27. Desire for their children to learn to use the VOCA 28. Parents keen to start implementing a VOCA with their children

Appendix 13

Study 3: OT interview transcript

Date of recording: 14/07/2017

Transcribed using notation described by Magnusson & Marecek (2015). 'I' refers to Interviewer, 'P' refers to Participant

Present:

Interviewer (I): Lead researcher and female SLT with 21 years' clinical experience

Participant (P): Female OT with 12 years' clinical paediatric experience

Languages involved: English with occasional interjections in Maltese

Transcriber: Lead researcher

Date of transcription: 01/08/2017 to 15/08/2017

I: today we are gonna talk about the kids who came for the intervention project and your perspective as an occupational therapist involved in this project. I am going to ask you 11 questions and this is the first question. I'm going to begin this interview with you telling me your experience of AAC interventions with children with ASD. What are your experiences of AAC to date?

P: My experience with AAC is with regards working together with a speech therapist and we have implemented low tech like PECS books and [emm] communication books as well as devices and we have been using the devices within [emm] within the sessions at home and at school within their natural environment

I: Are there any strategies that you think work or don't work when you try to teach children with a diagnosis of autism to use AAC?

P: Okay, there are a number of strategies that I use not always I think using the same strategies apply for like [emm] you might use some strategies for some children and not for others but I think for those children who have really severe sensory issues I think working with giving them the necessary input in order to

organise themselves is very important be- in order to see results towards using the AAC system so that is [emm] in terms of teaching why it's about working teaching them about their body so that they can know their body and they can use the the AAC device. Then other strategies that I think work from my from what I have observed is the use of structured teaching and the use of backward chaining and that you start teaching bit by bit [emm] how they need to use the the communication book or the device anything that you're using with them and within and across environments I think that is very important [er] that you make sure that this is taught across environments and across different objects as well I think.

I: okay. [emm] why do you think these strategies work?

P: the strategies work because actually what you are doing and I think what we've been doing and this is something that I do with everything that I teach with with regards to the way I I'm trained is task analysis so what we've done is analysed the situation we identified where is the difficulty that the child is having in the process of communication and we taught specifically the person with regards to that [emm] specific difficulty. We have adapted the environment in order to meet the needs of that particular [emm] student, for example, if a student had problems to access the device we had made it [emm] in their visual field maybe using other keyguards or make it possible that that person accesses the device eas- as easily as possible so that obviously you enhance the need and the opportunities for communication

I: Can you tell me a little bit more about these strategies?

P: Ok. When we..when I referred to adapting the environment I was [emm] referring to...like…putting any activities, any strategies that will provide for the sensory need of that child…for example…if a child is seeking movement [emm] we [emm] try to allow movement within the session while he's asking and this we observed has also improved access on the device. [emm] sometimes it would need for example giving rewards [emm] even through the activity like asking for certain rewards [emm] that were embedded within the device [emm] another

thing is putting structure, that is putting [emm] a table [emm] which is facing [emm] like less distractive environment like a clear wall so you lessen distractions
I: okay, thank you. [emm] are there any strategies that you think just don't try this with kids with autism?
P: silence (…….)
P: [laughing] [emm] I don't know, I think we are using [laughing] I think by time now I only remember the strategies that are good to use [laughing]. I think not being organised. I think with a child with autism you need to really be organised and with most of them you need a kind of schedule in order to show them what is going to happen and what they are going to do in that particular session because that will help them a lot in order to settle down and accept whatever is going to happen in that particular session, I think not being organised is something that you should avoid, you have to be really organised and [emm] another strategy is [emm] that you like this is about like you have to use mainly that being [emm] flexible in your therapeutic [approach] that you are, the use of yourself that you know, you have to know how adapt the use of yourself therapeutically with that child for example if the child is low arousal maybe you use your voice and how to use your voice, intonation to your voice making it more animated in order to get that child more alert. If you have someone who is more agitated, more…you need to use a calmer voice, more rhythmical voice in order to help him to calm down [emm] sometimes even your energy levels you have to match the child's and get him back to where you need him to be
I: in that last, in the last 2 studies we taught children to use AAC systems with 2 different display layouts
P: [hmm]
I: what was your, what's your opinion of the two display layouts?
P: [hmmmm] actually I don't think that there was much of a difference, there were children who have I think visual, visual scanning problems that I think the grid helped them much more but I don't think there was much of a difference because we had children who were doing very well with both with both [emm] scenes, oops, with both the grid and the scene

I: what about those children, especially in the first study who didn't do so well and didn't achieve criterion? Do you think there's a difference in displays for some children?
P: but I don't think the criterion was not achieved because of the display, I think the criteria were not reached because of the state of organisation of those particular children because they were too much disorganised, trying to meet their sensory needs and that was...like.. breaking a circuit because they wanted to communicate, they knew what they had to do but they couldn't really maintain and and maintain that movement pattern in order to use the device and so like it was always the sensory needs making a… they were breaking the need to communicate so I think…those…and that's why it led us to programming and trying to really meet the sensory needs in the sessions that came after
I: so…can I just [er] paraphrase what you said, what I understood and let me know if I'm on the right track. Are you saying that possibly addressing sensory needs in children who have sensory needs is possibly more important than the hardware?
P: [interrupts] I think so yes
I: the AAC
P: I think so because what I am seeing is that they have sensory motor issues and motor, and obviously we are seeing that in like co-or- motor inaccuracy, motor co-ordination but that is affecting the access of the device and when you try to, from my observations, when you manage and meet the needs of the children try to improve their motor skills then you have improvement in the use of the device.
I: okay, do you think that, you just said there accessing the device improves what about the act of communicating?
P: that also improves, especially what I'm seeing is that when you really go [emm] with them and you give them what they need and they like it they show you back a connection, they connect with you, they do eye contact, they laugh with you and they want you and they will come for you so I think that helps the communication and that they want to communicate, and then another thing is and then vocabulary

I: [emm] I would like to, you to think a little bit about sensory processing disorder and learning to use AAC in children with ASD, you've already mentioned sensory processing

P: yes

I: what's your opinion of the relationship between sensory processing disorders and children with ASD who are learning to use AAC, if you think there's any relationship at all?

P: yes, I think there is a relationship. There are studies that have shown that obviously children with autism have problems with motor issues and yes, then translate it into function? Yes it affects the use of a communication device or another communication system because you need to use your body so yes I think there is a relationship. And then the the problems with the motor aspect and the behaviour is mostly coming from the sensory [emm] prob- from the sensory issues they have

I: so you feel that the sensory issues underlie some of the motor issues?

P: yes, yes, yes and you can't separate them from each other, sensory and motor, because what we do is because of the sensory input we receive from the environment so you can't separate them so one will affect the other

I: so they're interlinked…

P: yes

I: you also said that the motor skills are required then to use AAC

P: [interrupt] to use AAC and that is where [emm] and I think not only the motor aspect, I think the sensory issues affect attention, sensory organisation will help also with eye hand co-ordination with visual attention so these are all interlinked, these are all needed in order to access a device properly So I think there is a relationship because we've been observing, I've been observing it before cos I have noticed even when working like doing just occupational therapy with children and working on the floor and playing and giving them vestibular and proprioceptive input heavy work, the children were speaking much more in my sessions then in other sessions with the speech therapist so I already [emm] started to see that the children were able to connect, they are, I think working

and giving them the necessary input enables them to connect with you and thus to really communicate with you so I think that helped with the social skills, the nonverbals I think, that helped them to improve the nonverbal skills and obviously identify why they need to use something else to communicate rather than their their normal gestures or everything that they use
I: [emm] can you tell me a little bit more, you're saying then that you think the sensory processing is something that needs to be done before
P: [interrupts] yes. I think, so, I think there is one so those children who have, because not all the children with autism have sensory processing issues, also not every child has severe sensory processing issues but what I've noticed is that those who have severe, severe sensory processing issues have difficulty to communicate as well so [emm] the thing is for certain children they need to have it [emm] like before communicating, [emm] I think initially, but I think I can, I I I believe in working with an AAC device while doing sensory processing intervention, I think you would have similar effects, the same like if you're doing sensory processing issues, sensory processing or lets say SI training [emm] SI intervention before and, and then you implement the AAC intervention after but I have seen the same results even when you integrate both so you can, I haven't seen any difference between either putting it before and then you put the sensory input before and then you use the AAC after, implementation of AAC, and I have seen similar results when we incorporate them together, like, having the SI intervention in a sensory motor and [emm] AAC incorporated into that. I think I feel much more comfortable to do that to increase, to introduce immediately [emm] an AAC device within such a setting especially when working with a nonverbal child because [.] when I'm playing with them I'm communicating and that will give me a lot of opportunities to teach the use of an AAC device
I: you said not all children with ASD have a sensory processing difficulty, do you have any thoughts on teaching AAC use to those kinds of children?
P: I think then for those kinds of children I think teaching AAC device use you go with like behavioural strategies of like [emm] physical prompting, modelling and I think those would be just enough and then you fade, you do the fading

accordingly they will learn to use. Some of them probably, you show them once and they are able to do it

I: so what we're saying here is that possibly OT input is not as necessary..

P: yeah...in such cases

I: you also mentioned the term severe sensory processing issues, and that when they're severe they often have more difficulties to communicate [emm] my question was what do you, what to you is a severe sensory processing issue?

P: I think it's when all the patterns are affected, when all the sensory patterns are affected and there is like.. there are difficulties and and definite difference in [emm] let's say most of the systems, like for example they have difficulty [emm] with registering proprioceptive input, they seek vestibular input, they have difficulties with visual with oral motor skills so like most of the sensory systems are affected

I: and how would you know that?

P: then you know it from your observations and from a Sensory Profile or other test that you would administer

I: [emm] can you describe to me the process of how you typically go about assessing sensory processing disorders in children with a diagnosis of autism?

P: so, there are obviously from clinical observations, [emm] from parental interviews and even from standardised assessments, like [emm] Sensory Profile etc and I think information from all of these [emm] assessments will give you the opportunity to interpret what is going on in that child and then you plan your intervention accordingly

I: I'd like to know more about the possible interventions for sensory processing disorders, can you describe it in as much detail as possible the kinds of interventions you typically provide for children with ASD and co-existing sensory processing disorders?

P: so,[cough] so there is one, so you can provide either strategies which can be implemented into the environment, [emm] and also you can implement and give treatment within a sensory motor room where you will provide the necessary input, sensory input, that that child needs and also to encourage him to move into

the level, what we call, [emm] one [emm] the adaptive response in order so that he is doing something, he can [emm] plan, [emm] something and do it [emm] so not not only you provide the sensory input but the child is doing something with his body and increasing the challenge accordingly so that he can master for example, like for example you might start with a child [emm] leading the session to an extent, so you would have like following a child and then try to use that situation in order to get what you want and then bit by bit so before the child was going from one equipment to the other but with no, [emm] like [emm] not [emm] no process in regard but and then you can move him in order to be able to follow an obstacle course, for example, so that he is able to follow instructions, able to move from one equipment to the other, so he needs to do problem solving as well, so basically it's a process I think, first getting the child to interact with you, to communicate with you, to have [like] that therapeutic relationship so that you can move him from one level to the other, and also like, for example working on, on, if, like trying to get the systems at the just right level, like vestibular system, proprioceptive system or in those children who have problems with discrimination you try to improve their discrimination, those children who have sensitivities you try to inhibit, to, like, desensitise that system so that they can be able, more able to interact with their environment [emm] etcetera

I: Earlier on you mentioned environmental strategies as one of the things you can do, [emm] you described it a little bit, you talked about the room

P: Yes

I: what to you are environmental strategies in the context of sensory motor..

P: maybe that…as I explained before I think putting in movement in it, [err] maybe you can also add like...a ball, a gym ball and you give [emm] jumping on the ball while, while playing with it [emm] maybe [emm] doing in between some, if they're asking for go you can go with a wheelbarrow instead of running so you can, you can, you know that you're putting movement but [emm] heavy work type of movement within the sessions, so that's one thing. It could also be providing [emm] tactile input through deep pressure on the shoulders, show them how to do self-hugs and all of these in order to provide proprioceptive inputs

I: you mentioned adaptive response, what does that mean to you?
P: mela, the adaptive response is [pause] that thing that the child is able to [emm] do [emm] participate in an activity [emm] is able to do that part on his own without the help [emm] okay? You put that challenge and he's able to [emm] get into that challenge, overcome that challenge and then you move, that's the adaptive response
I: okay, and you also mentioned the just right
P: yes, just right is the ability to have attention [emm] to maintain attention which is appropriate and you have the appropriate level of energy for that particular activity, that you can maintain attention and can concentrate
I: [emm] you mentioned as well proprioceptive and vestibular systems, can you tell me a bit about the systems
P: so, proprioceptive in- system is [emm] the receptors that we find in every joint and it gives us [emm] information about posi-, body position, about how much we need to push, how much we need to pull etcetera. Vestibular system is located in the inner ear and it gives us information about [emm] balance, about the gravity, where we are in relation to the gravity, it gives us the movement sense practically
I: and are there other systems?
P: there are obviously the 5 systems that we know: the tactile, the visual system [emm] the smell system [emm] the taste and the auditory system
I: you also mentioned sensitivities, are there different kinds of profiles?
P: yes, there is. There are children who might be oral sensitive, like they have problems with oral motor, so they might be very [umm] sensitive to different textures or different tastes, you have others, they can't tolerate anything, not anything but certain textures on their body so if obviously if someone touches them they would react negatively to to the people or they don't tolerate clothes on them, certain clothes, so yes these things might co-exist together or they might present only separately so you have different profiles
I: [emm] so, you can be sensitive, is there another kind of sensory profile that could be there?

P: so, you can either not register, so you need a lot of input in order to register a sensation. You can be registering a lot so that you makes you sensitive, [emm] you can seek also and this is very easy to notice in children because you see them jumping, you see them moving, you see them pushing and pulling or anything or maybe like trying to make noises etcetera so you can see the seeking and then there are children who avoid who avoid being with people, who avoid [emm] certain activities [emm] etcetera
I: okay. [emm] so we had four children in the last study, [emm] how did you decide what intervention to provide for each of those children
P: it depends on the results that you, that have been obtained through observations and through the scoring of the Sensory Profile and then, obviously, identifying which systems are involved and where is the problem then the [emm] treatment is given in order to help [emm] to work and restore those systems
I: [emm] for one of the children, Z, we changed the treatment, can you tell me what lead you to that point?
P: so, in that case, because we started to give him some strategies within the session but that was not enough and the reason was [cough] because the problems were with [emm] were difficulties for [emm], he was having difficulty in order to [emm] discriminate between the movement so he had also problems with grading, what we call grading of the force and how they can, he grade, use [emm] his movements according to different activities so he needed intervention with regards to start discriminate that particular [emm] sensory, in his case the vestibular proprioceptive systems were [emm] like, really not being processed by the brain practicament.
I: so is discrimination another kind of sensory profile, a problem with discrimination?
P: yes, it's one, it's another difficulty, it can co-exist with for example poor registration
I: do you think that learning to discriminate is a necessary skill for learning to use AAC?

P: it is a necessary skill to move around [laughs] and it is so it is, so obviously it is a necessary skill to do some thing and manipulate things around you so then obviously it's going to affect how to use an AAC device as much as it is going to affect doing other functional activities

I: So the sensory profiles we spoke about before, they are sensory modulation...and this is another type of sensory processing disorder in the classification

P: yes, yes, yes, yes, yes and there are others obviously like, not necessarily presenting as sensory modulation but they could be a sensory based motor problems

I: okay. [emm] so we had four children in the last study and you provided sensory based interventions to all four of them. [emm] what happened when you did that? What was the result? Or no result?

P: when we provided the intervention?

I: mmm ((head nod))

P: I think for all of them it was a very positive result, some of them [emm] were okay by providing them strategies within the, within the clinic room, they didn't need major adaptations, they just needed adaptations to the environment and they responded very well. Others needed a lot of intervention within the sensory motor room but we could see that this really helped to improve their attention, to be able to [emm] identify, communicate, start to notice their environment much more and even were much more organised then in order to be able to cope with [emm] communicating using the device.

I: [emm] for those children, earlier on you mentioned that you like the idea of introducing AAC and sensory intervention together, right, [emm] are you talking about in the clinic room or in the sensory motor room…

P: in a sensory motor room because it's easier, it's like you have the equipment, you can move the equipment, you can in- include [emm] like during the session introduce other equipment and then you can gauge according to the child and what is happening at that point in time.

I: so for the 2 children that didn't go in the sensory motor room this time, would you consider that they could have gone into it?
P: not exactly, I would still maintain that they would use the device within the clinics and hopefully we would introduce it into other environments
I: [emm] how do you feel about a speech and language therapist implementing sensory based interventions when working with children with ASD who are learning to use AAC?
P: can you repeat the question?
I: how do you feel about an SLT implementing sensory based interventions when working with children with ASD who are learning to use AAC?
P: I think if [pause] some strategies can be, one, I think for certain other things they need to be trained in use, in sensory integration obviously because it is much more complex but I've been working with other speech therapists who I've given some recommendations like I give parents and I like give, I give teachers and they can implement them during their session and they have, like, some of them, like replied back that they had success by putting in strategies but obviously when you have like children who have like, really need treatment within SI [emm] I think then [emm] they, an occupational therapist needs to be involved
I: so, thinking to the last 4 children in the last study, can you relate that?
P: yes, obviously we had like 2 who I think their speech therapist, if like, given strategies they can implement it within the clinic or where they are working with but we had another 2 that they needed specialised treatment
I: so what was different in their sensory assessments?
P: [emm] the difference was that the other 2 that needed more intervention they had more difficulties, there was more definite difference in a lot of areas, and the others were mainly only seeking behaviours, and the others had poor registration most of them and sensory discrimination. I think those were the most, from my experience, I'm seeing that those who have poor registration or those who have poor discrimination, they are the ones having the problems to communicate

I: so you think that, going back to the original question about the speech therapist implementing, that, [emm] a speech therapist may be able to implement according to the profile and the areas they have difficulty in?
P: can you explain it better?
I: okay, you said there that the two children, that, you [emm] you feel that need an OT to implement the sensory based intervention, that their profiles were more definite differences in more areas
P: [hmm] ((nodding))
I: so do you think that this is one of the factors that means an OT has to get involved?
P: yes, yes, yes, probably, I think you need to do [laughing] more now [emm] like more research on this, in order to see if most of [laughing] because these are my observations but I think either we need to base it on more [emm] research so that to see if these patterns are actually correlating with children who have communication difficulties or difficulty to learn to use [emm] communication devices
I: that brings me nicely to my next question, are there any changes that you would suggest to the study design if you were going to implement this again for four more children with co existing diagnosis of ASD and sensory processing disorder?
P: [……] it depends on [laughing] exactly if we want to know now of certain profiles, certain sensory profiles are having communication difficulties, then obviously you need to have a group of those that have that type of, that kind of pattern versus another group, that maybe they don't have and then we'll see if both of them implement them. I'm getting mixed up.
I: so if we had to make a change to the next study what would we do?
I: so we were talking about any changes that you would make to the study design
P: [interrupts] yes
I: if you were going to implement sensory based interventions again to four more children

P: You need to have more children to have them graphed or put on a table in order to really see the difference and that you obviously you can maybe you do it over a large number of people in order to make it more robust and more standardised and more like [emm] obviously standardised over populations
I: if we knew that, if we knew that for example certain profiles are more likely to have certain difficulties how would that help in terms of AAC do you think?
P: I think it would help obviously because it would help, you can identify those students that would need the input of an OT together with a speech therapist, I think, that even for the speech therapist I think it would be good information that they would know hmm in these cases I think I need to work with an OT much more and maybe even ask where possible to work together and if not possible maybe to see what they can do [emm] in order what they can do in their sessions by asking the OT and maybe that would help them to implement AAC teaching but I think the most important thing is that you know that these children are the children that if you're not going to put sensory based interventions in place they're still going to have problems with the use of the AAC device and thus if you put sensory based [emm] strategies you are going to achieve [emm] learning of a device in much less time…
I: so you are referring to efficiency?
P: yes, efficiency. So I think that it might make us more effective especially...it would be interesting to see speech therapist's perceptions on how, on teaching certain things and if they are finding it difficult and then obviously how long they think…sometimes I heard [emm] speech therapists saying they have worked on something for a long time and they haven't achieved it...then once you implement sensory based strategies you achieve it much faster
I: how do you feel about working with a speech therapist, something you do everyday here?
P: I think I have learned also myself, because obviously [emm] now I have a tool like because obviously when you are working with a child you have to communicate with him, if you don't have a system to communicate with him I think it's like doing a thing but not really gaining that relationship with the child. I

think having then implemented an AAC device in the session it gives the child the opportunity to connect with the therapist much more and I think that was great because I think [emm] working with a speech therapist gave me the opportunity to see the child more holistically

I: we spoke about more children and looking at sensory profiles and how we provide intervention, do you have any other ideas for the future if we can only see 4 children? What could we do that is maybe different than last time?

P: hmmm. I think either trying to see...to do it like an immersive like type of thing doing a sensory motor intervention with the AAC device together and see the effectiveness and then maybe compare that with not doing the sensory intervention but separately

I: if we did that, we were teaching children to pick up the device, would we still do that?

P: yeah…definitely and that they go spon-…I think something that I would love to see is that the child would go spontaneously to the device, maybe not initially, but by time that is what you want to achieve ...so going spontaneously to the device is something which yes has to be taught and it will hopefully be achieved and it should be included I think yes

I: so you envisage that the child wouldn't learn the whole motor action of picking up the device and giving it and reaching with it

P: no because I think in such a session there's a lot of things he is trying to learn so my focus first is that we get the play going and the asking or the requesting or the commenting going around that, then once the child is co-ordinating those things so he is going to the device to ask to go again for that game or to ask more of that particular game and then this is moving on, then it will be the next step in order to teach him that he will go to the device to somebody to another person. You can't do everything at the same time.

I: do you have any other thoughts on future research?

P: From what I observed, my hypotheses is that certain, those children who have poor registration and or discrimination problems were the most, the children had difficulty to learn to use the AAC device, so my hypothesis is that, but obviously

this needs to be confirmed. Like, is it true or is it not? [emm] and then obviously this will lead us, if this is true this will lead us to see the importance of implementing when you're, when you're teaching children with ASD, the importance of implementing sensory strategies immediately within their sessions and while they are learning to use communication devices as well so that it would be part of the treatment so you're working on their sensory processing while implementing [emm] the AAC but obviously this has to, we have to also see how this is beneficial [.] in the long term, so this is what we have observed but you have to see how now it is [emm] how efficient it is in children getting [emm] [emm] actually learning their AAC. Is it this way they learn the AAC fast or is it the way we're doing it normally? How does it compare?
I: okay. [emm] so are you saying that you think that the AAC teaching needs to be combined
P: [interrupts] yes
I: with intervention that targets the sensory processing disorder?
P: [yes] because I've seen an import-, first of all we know research let's start from there we know research that when you [emm] stimulate the vestibular system you are also stimulating like [emm] the area let's say of the vocals and etcetera so I don't know that link into communication but obviously [emm] like what I've seen is that when you give movement to children they are much more ready to communicate with you so that's why I see the importance of implementing and teaching an AAC system [emm] into such a situation.
I: so are we talking that one professional could do this?
P: probably I think it would be best to have 2 professionals doing it together so that the session is being run by 2 therapists. You have the OT who is [emm] obviously putting up the equipment and working with the child and then the speech therapist who's seeing the opportunities in order and seeing which language they need and which words are important in order to be taught.
I: okay. And your own professional background?
P: so, [emm] I have a degree in occupational therapy and I have also a masters in inclusive education and communities. I've been working in the area of paediatrics

for now [emm] 12 years and I have done also courses on [emm] sensory processing and [emm] in that area. It's not sensory integration [emm] which hopefully I will be starting soon but it's like a course on [emm] sensory processing and praxis and [emm] postural skills.

I: is there anything else that you expected me to ask you about?

P: No

I: is there anything else you want to add about your involvement so far in this project?

I: it was a nice experience actually [laughing]

P: why was it a nice experience?

I: because obviously I, because actually [emm] I've been observing certain things through my practice but then when you see it really working and you see the children really then communicating much much then you see it again you see it even [emm] being [emm] tabulated then obviously it will strengthen your observations and it gives you more thoughts and more [emm] questions to answer and find research or do research about

I: what kind of things had you seen in your practice? That this has linked to for you?

P: actually that I have referred to it, that whenever I use, like I have like parents coming to me and telling me that the child does not speak or the child does not use the device automatically when in a speech therapy session but in your session he does use it because I am, I'm playing and they are at ease and they are having fun the children and they actually, those who are able to verbalise they would verbalise and those who are able to use a device will want to use the device in order to continue the process of play and to maintain what they are liking about that particular play, for example if they want to bounce on the ball or jump on the trampoline they are going to tell you more of that.

I: I just wanna go back to [emm] changes to study design, we used two displays in the last study, do you have any thoughts on that?

P: the grid versus the visual scene?

I: yes

P: like [..] since I don't, since I don't think it's the most important thing, I don't think it's the most important thing because I've seen the same problems of [emm] mainly the problems that were, that were affecting the child in order to learn or to use the device is because it was being interfered by the need to [emm] get the sensory input so either because [emm] they were going to communicate and suddenly they are, they lose attention or they need to go and press something or to get, or jump so it was being like cut off so that the process of communication couldn't be [emm] fluent to say so but this was improved once we gave them the sensory input because then communication started to be fluent

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60 minutes 5 seconds

Appendix 14

Study 3: Thematic analyses- interview

Phase 1: coding- Study 3

Data extract	Initial codes
I: today we are gonna talk about the kids who came for the intervention project and your perspective as an occupational therapist involved in this project. I am going to ask you 11 questions and this is the first question. I'm going to begin this interview with you telling me your experience of AAC interventions with children with ASD. What are your experiences of AAC to date?	
P: My experience with AAC is with regards working together with a speech therapist we have implemented low tech like PECS books and communication books as well as devices we have been using the devices within the sessions at home and at school within their natural environment	
I: Are there any strategies that you think work or don't work when you try to teach children with a diagnosis of autism to use AAC?	
P: Okay, there are a number of strategies that I use…not always I think using the same strategies apply for like [emm] you might use some strategies for some children and not for others	• Intervention strategies are numerous • Not all children require the same intervention strategies

but I think for those children who have really severe sensory issues I think working with giving them the necessary input in order to organise themselves is very important be- in order to see results towards using the AAC system so that is [emm] in terms of teaching why it's about working teaching them about their body so that they can know their body and they can use the, the AAC device. The use of structured teaching, use of backward chaining, that you start teaching bit by bit within and across environments I think that is very important [er] that you make sure that this is taught across environments across different objects as well I think.	• Necessity of sensory based intervention to learn AAC • Severity of SI impacts on learning AAC use • Organising the self is important to learn AAC • Severe sensory processing issues require sensory based interventions • Body awareness is important to learn AAC use • Structured teaching is important • Behaviourist strategy are used • Task analysis is needed • Different environments are needed for teaching AAC • Different objects are needed in the AAC intervention process
I: okay. [emm] why do you think these strategies work?	
P: the strategies work because actually what you are doing and I think what we've been doing and this is something that I do with everything that I teach with with regards to the way I I'm trained is task analysis. So what we've done is analysed the situation we identified where is the difficulty that the child is having in the process of communication and	• Task analysis is used during the AAC intervention • Matching teaching procedure to child's needs • Teaching AAC device needs to be specific to the child

we taught specifically the person with regards to that [emm] specific difficulty. We have adapted the environment in order to meet the needs of that particular [emm] student for example if a student had problems to access the device we had made it [emm] in their visual field maybe using other keyguards or make it possible that that person accesses the device eas- as easily as possible you enhance the need and the opportunities for communication	• Matching the environment to child's sensory needs is important • Environment adaptations support making the AAC device as easy to use as possible • It is important to create the need to communicate • Creating opportunities to communicate is important
I: Can you tell me a little bit more about these strategies?	
P: when I referred to adapting the environment I was [emm] referring to...like…putting any activities, any strategies that will provide for the sensory need of that child…if a child is seeking movement [emm] we [emm] try to allow movement within the session while he's asking This (movement) we observed has also improved access on the device, sometimes it would need for example giving rewards [emm] even through the activity like asking for certain rewards [emm] that were embedded within the device another thing is putting structure, that is putting [emm] a table [emm] which is facing [emm] like less distractive environment like a clear wall so you lessen distractions	• Matching environment to child's sensory needs is important • Combining sensory activities with AAC intervention • Positive effect of combining sensory activity with AAC intervention Movement can improve motor access to AAC device • Using motivators/rewards is a strategy in AAC interventions Environmental modifications to improve attention

I: okay, thank you. [emm] are there any strategies that you think just don't try this with kids with autism?	
P: silence (…….) P: [laughing] [emm] I don't know, I think we are using [laughing] I think by time now I only remember the strategies that are good to use [laughing] I think not being organised. I think with a child with autism you need to really be organised, with most of them you need a kind of schedule in order to show them what is going to happen and what they are going to do in that particular session because that will help them a lot in order to settle down and accept whatever is going to happen in that particular session. I think not being organised is something that you should avoid, you have to be really organised. Another strategy is [emm] that you like this is about like you have to use mainly that being [emm] flexible in your therapeutic [approach] that you are, the use of yourself that you know, you have to know how adapt the use of yourself therapeutically with that child. If the child is low arousal maybe you use your voice and how to use your voice, intonation to your voice making it more animated in order to get that child more alert. If you have someone who is more agitated, more…you need to use a calmer voice, more rhythmical voice in order to help him to calm down. Sometimes even your energy levels you	• There needs to be flexibility in therapeutic approach • Adapting therapeutic self to child is needed • Sensory based strategy-low arousal-therapist adaptation in communication • Sensory based strategy-high arousal-therapist adaptation of communication • Energy levels: sensory based intervention-therapist adaptation to child's level • Schedules are helpful during AAC interventions • There needs to be flexibility in therapeutic approach • Adapting therapeutic self to child is needed • Sensory based strategy-low arousal-therapist adaptation in communication

have to match the child's and get him back to where you need him to be	• Sensory based strategy-high arousal-therapist adaptation of communication • Energy levels: sensory based intervention-therapist adaptation to child's level • There needs to be flexibility in therapeutic approach • Adapting therapeutic self to child is needed • Sensory based strategy-low arousal-therapist adaptation in communication • Sensory based strategy-high arousal-therapist adaptation of communication • Energy levels: sensory based intervention-therapist adaptation to child's level
I: in that last, in the last 2 studies we taught children to use AAC systems with 2 different display layouts	
P: [hmm]	
I: what was your, what's your opinion of the 2 display layouts?	

P: actually I don't think that there was much of a difference (between display layouts). There were children who have I think visual, visual scanning problems that I think the grid helped them much more but I don't think there was much of a difference because we had children who were doing very well with both with both [emm] scenes, oops, with both the grid and the scene	• Opinion of displays: no difference • Displays: grid is better • Grid might be better for children with visual scanning issues
I: what about those children, especially in the first study who didn't do so well and didn't achieve criterion? Do you think there's a difference in displays for some children?	
P: but I don't think the criterion was not achieved because of the display. I think the criteria were not reached because of the state of organisation of those particular children because they were too much disorganised, trying to meet their sensory needs…that was..like.. breaking a circuit because they wanted to communicate, they knew what they had to do but they couldn't really maintain and and maintain that movement pattern in order to use the device. It was always the sensory needs making a… they were breaking the need to communicate so I think and that's why it led us to programming and trying to really meet the sensory needs in the sessions that came after	• Display did not impact on whether criterion was achieved • Achieving criterion is linked to sensory state • Child disorganisation affects learning to use AAC • Sensory state can have an impact on learning AAC device use • Need movement patterns to learn to use AAC • Sensory state can negatively impact ability to communicate • Combining sensory activities with AAC

	intervention could be helpful
I: so…can I just[er] paraphrase what you said, what I understood and let me know if I'm on the right track. Are you saying that possibly addressing sensory needs in children who have sensory needs is possibly more important than the hardware?	
P: [interrupts] I think so yes	
I: the AAC	
P: I think so because what I am seeing is that they have sensory motor issues and motor, and obviously we are seeing that in like co-or-motor inaccuracy, motor co-ordination that is affecting the access of the device (sensory motor skills) when you manage and meet the needs of the children try to improve their motor skills then you have improvement in the use of the device.	• Sensory motor issues can exist in children with ASD • Sensory motor skills are linked to co-ordination and accuracy of motor movements • Sensory motor skills issues can affect access on the device • Improving motor skills leads to learning to use the AAC device
I: okay, do you think that, you just said there accessing the device improves what about the act of communicating?	
P: That also improves, especially what I'm seeing is that when you really go [emm] with them and you give them what they need (sensory based) and they like it they show you back a connection, they connect with you, they do eye contact, they laugh with you and they	• AAC intervention: follow child's lead combined with sensory intervention supports forming a connection

want you and they will come for you so I think that (SB interventions) helps the communication and that they want to communicate, and then another thing is and then vocabulary… then another thing is and then they start realising [pause] that yes this is how I get what I want, and what I want is what I like… obviously from there you can expand more	• Nonverbal communication improves during sensory based interventions • AAC intervention: setting the scene using sensory based interventions supports provides motivation for communication/interaction • Sensory based interventions can give children a reason to communicate • Creating motivation is important • It is possible to go beyond requesting with AAC devices
I: [emm] I would like to, you to think a little bit about sensory processing diffculty and learning to use AAC in children with ASD, you've already mentioned sensory processing	
P: yes	
I: what's your opinion of the relationship between sensory processing difficulty and children with ASD who are learning to use AAC, if you think there's any relationship at all?	

P: Yes, I think there is a relationship. There are studies that have shown that obviously children with autism have problems with motor issues, then translate it (motor issues) into function? Yes it affects the use of a communication device or another communication system because you need to use your body so yes I think there is a relationship. The problems with the motor aspect and the behaviour is mostly coming from the sensory [emm] prob- from the sensory issues they have	• Sensory processing issues & learning to use an AAC device are linked • ASC is linked to motor issues • Motor issues can impact a child's ability to carry out functional activities • ASC & sensory processing issues impact learning to use AAC device • AAC device requires use of the body • Sensory processing issues impact motor skills
I: so you feel that the sensory issues underlie some of the motor issues?	
P: yes, yes, yes and you can't separate them from each other, sensory and motor, because what we do is because of the sensory input we receive from the environment so you can't separate them so one will affect the other	• Relationship between sensory processing issues and motor issues is intertwined
I: so they're interlinked	
P: yes	
I: you also said that the motor skills are required then to use AAC	

P: [interrupt] to use AAC and that is where [emm] and I think not only the motor aspect, I think the sensory issues affect attention, sensory organisation will help also with eye hand co-ordination with visual attention so these are all interlinked, these are all needed in order to access a device properly cos I have noticed even when working like doing just occupational therapy with children and working on the floor and playing and giving them vestibular and proprioceptive input heavy work, the children were speaking much more in my sessions then in other sessions with the speech therapist so I have already [emm] started to see that the children were able to connect, they are, I think working and giving them the necessary input enables them to connect with you and thus to really communicate with you so I think that helped with the social skills, the nonverbals I think, that helped them to improve the nonverbal skills obviously identify why they need to use something else to communicate rather than their their normal gestures or everything that they use	• Motor skills required to learn AAC • Sensory processing issues impact learning AAC device use • Sensory processing issues can impact attention, • Sensory organisation supports eye hand co-ordination • Sensory organisation supports visual attention • There is a link between sensory based interventions & talking • Sensory processing supports nonverbal skills • Sensory input supports the ability to connect • Being able to connect supports communication
I: [emm] can you tell me a little bit more, you're saying then that you think the sensory processing is something that needs to be done before	

P: I think, so I think there is one so those children who have, because not all the children with autism have sensory processing issues, also not every child has severe sensory processing issues. What I've noticed is that those who have severe, severe sensory processing issues have difficulty to communicate as well. The thing is for certain children they need to have it [emm] like before communicating, [emm] I think initially but I think I can, I I I believe in working with an AAC device while doing sensory processing intervention. I think you would have similar effects, the same like if you're doing sensory processing issues, sensory processing or lets say SI training [emm] SI intervention before and then you implement the AAC intervention after but I have seen the same results even when you integrate both so you can, I haven't seen any difference between either putting it before and then you put the sensory input before and then you use the AAC after, implementation of AAC and I have seen similar results when we incorporate them together, like, having the SI intervention in a sensory motor and [emm] AAC incorporated into that. I think I feel much more comfortable to do that to increase, to introduce immediately [emm] an AAC device within such a setting especially when working with a nonverbal child. when I'm playing with them I'm communicating that will	• Timing of sensory processing input can be before AAC input • Sensory processing input & AAC intervention: location could be a sensory motor room • Sensory based interventions involve play • Sensory based interventions involve communication • Play provides opportunities in sensory based interventions for AAC intervention • Sensory based interventions provide opportunities for teaching AAC device use

give me a lot of opportunities to even teach the use of an AAC device	
I: you said not all children with ASD have a sensory processing difficulty, do you have any thoughts on teaching AAC use to those kinds of children?	
P: I think then for those kinds of children I think teaching AAC device use you go with like behavioural strategies of like [emm] physical prompting, modelling and I think those would be just enough and then you fade, you do the fading accordingly they will learn to use. Some of them probably, you show them once and they are able to do it	• AAC intervention strategies for children who don't have sensory processing issues: behaviourist strategies, modelling, fading • Children who don't have sensory issues learn faster, no need for OT input
I: so what we're saying here is that possibly OT input is not as necessary	
P: yeah...in such cases	
I: you also mentioned the term severe sensory processing issues, and that when they're severe they often have more difficulties to communicate [emm] my question was what do you, what to you is a severe sensory processing issue?	
P: I think it's when all the patterns are affected, when all the sensory patterns are affected and there is like.. there are difficulties and and definite difference in [emm] let's say most of the systems, like for example they have difficulty [emm] with registering proprioceptive input, they seek vestibular	• Definition of severe sensory processing issue is when all sensory processes are affected

input, they have difficulties with visual with oral motor skills so like most of the sensory systems are affected	
I: and how would you know that?	
P: then you know it from your observations from a Sensory Profile or other test that you would administer	• Informal assessments are used to assess sensory processing • Formal assessments are used to assess sensory processing
I: [emm] can you describe to me the process of how you typically go about assessing sensory processing difficulties in children with a diagnosis of autism?	
P: there are obviously from clinical observations from parental interviews…even from standardised assessments, like [emm] Sensory Profile and I think information from all of these [emm] assessments it will give you the opportunity to interpret what is going on in that child and then you plan your intervention accordingly	• Informal observations are used to assess sensory processing • Parental interviews are used to assess sensory processing • Formal assessments are used to assess sensory processing • Information from assessments is integrated • Assessment results are used to plan intervention
I: I'd like to know more about the possible interventions for sensory processing difficulties, can you describe it in as much detail as possible the kinds of interventions you	

typically provide for children with ASD and co-existing sensory processing difficulties?	
P: so you can provide either strategies which can be implemented into the environment also you can implement and give treatment within a sensory motor room where you will provide the necessary input, sensory input, that that child needs to encourage him to move into the level, what we call, [emm] one [emm] the adaptive response in order so that he is doing something, he can [emm] plan, [emm] something and do it [emm] so not not only you provide the sensory input but the child is doing something with his body and increasing the challenge accordingly so that he can master for example, like for example you might start with a child [emm] leading the session to an extent, so you would have like following a child and then try to use that situation in order to get what you want and then bit by bit so before the child was going from one equipment to the other but with no, [emm] like [emm] not [emm] no process in regard but and then you can move him in order to be able to follow an obstacle course, for example, so that he is able to follow instructions, able to move from one equipment to the other, so he needs to do problem solving as well, so basically it's a process I think first getting the child to interact with you, to communicate with you, to have [like] that	• Environmental modifications are a type of sensory based intervention • A sensory motor room can be used for sensory based interventions • The adaptive response is the goal of sensory based interventions • Goal setting includes sub goals • Communication plays an important role in forming a therapeutic relationship in sensory based interventions • The just right challenge is a goal of sensory based interventions • Discrimination skills are a part of sensory processing • Discrimination needs to be targeted if there is a problem • Sensitivities are a part of sensory processing • Sensitivities need to be worked on if there is a problem

therapeutic relationship so that you can move him from one level to the other, to have [like] that therapeutic relationship so that you can move him from one level to the other, and also like, for example working on, on, if, like trying to get the systems at the just right level, like vestibular system, proprioceptive system. In those children who have problems with discrimination you try to improve their discrimination those children who have sensitivities you try to inhibit, to, like, desensitise that system so that they can be able, more able to interact with their environment [emm] etcetera	
I: Earlier on you mentioned environmental strategies as one of the things you can do, [emm] you described it a little bit, you talked about the room	
P: Yes	
I: what to you are environmental strategies in the context of sensory motor?	
P: maybe that…as I explained before I think putting in movement in it, [err] maybe you can also add like..a ball, a gymball and you give [emm] jumping on the ball while, while playing with it [emm] maybe [emm] doing in between some, if they're asking for go you can go with a wheelbarrow instead of running so you can, you can, you know that you're putting movement but [emm] heavy work type of movement within the sessions, so that's one	• Environmental modifications can take different forms • Sensory based interventions can be embedded within AAC sessions • Movement goals can be set as part of sensory based interventions

thing. It could also be providing [emm] tactile input through deep pressure on the shoulders, show them how to do self hugs and all of these in order to provide proprioceptive inputs	Sensory based interventions include environmental modifications
I: you mentioned adaptive response, what does that mean to you?	
P: mela [maltese language interjection meaning 'so'] the adaptive response is [pause] that thing that the child is able to [emm] do [emm] participate in an activity [emm] is able to do that part on his own without the help [emm] okay? You put that challenge and he's able to [emm] get into that challenge, overcome that challenge and then you move, that's the adaptive response	• The adaptive response is the goal of sensory based interventions
I: okay, and you also mentioned the just right	
P: yes, just right is the ability to have attention [emm] to maintain just rif which is appropriate and you have the appropriate level of energy for that particular activity, that you can maintain attention and can concentrate	• Sensory processing intervention involves the just right challenge • Being at the 'just right' level is needed for attention
I: [emm] you mentioned as well proprioceptive and vestibular systems, can you tell me a bit about the systems	
P: so, proprioceptive in- system is [emm] the receptors that we find in every joint and it gives us [emm] information about posi-, body position, about how much we need to push, how much we need to pull etcetera. Vestibular system is located in the inner ear and it gives	• Sensory processing system includes proprioception • Sensory processing system includes the vestibular system

us information about [emm] balance, about the gravity, where we are in relation to the gravity, it gives us the movement sense practically	
I: and are there other systems?	
P: there are obviously the 5 systems that we know: the tactile, the visual system [emm] the smell system [emm] the taste and the auditory system	• Sensory processing system: 5 other sensory systems apart from propricoceptive and vestibular systems
I: you also mentioned sensitivities, are there different kinds of profiles?	
P: yes there is. There are children who might be oral sensitive, like they have problems with oral motor, so they might be very [umm] sensitive to different textures or different tastes. You have others, they can't tolerate anything, not anything but certain textures on their body so if obviously if someone touches them they would react negatively to to the people or they don't tolerate clothes on them, certain clothes, yes these things might co-exist together or they might present only separately so you have different profiles	• Sensory processing classification: sensitivities • Some children have oral sensitivities • Sensory processing classification: hyper-reactive • Some children have tactile sensitivities • Sensory processing classification: separate or coexistence of different profiles
I: [emm] so, you can be sensitive, is there another kind of sensory profile that could be there?	

P: you can either not register, so you need a lot of input in order to register a sensation You can be registering a lot so that you makes you sensitive. you can seek also and this is very easy to notice in children because you see them jumping, you see them moving, you see them pushing and pulling or anything or maybe like trying to make noises etcetera so you can see the seeking so that mainly. Then there are children who avoid who avoid being with people, who avoid [emm] certain activities [emm] etcetera	• Sensory processing classification: hypo-reactive • Sensory processing classification: hyper-reactive • Sensory processing classification: sensory seeking • Sensory processing classification: sensory avoiding
I: okay. [emm] so we had four children in the last study, [emm] how did you decide what intervention to provide for each of those children	
P: it depends on the results that you, that have been obtained through observations and through the scoring of the Sensory Profile and then , obviously, identifying which systems are involved and where is the problem then the [emm] treatment is given in order to help [emm] to work and restore those systems	• Treatment is planned to restore sensory processing as a result of assessments • Sensory processing: goal of treatment is to balance sensory systems
I: [emm] for one of the children, Z, we changed the treatment, can you tell me what lead you to that point?	
P: so, in that case, because we started to give him some strategies within the session but that was not enough and the reason was [cough] because the problems were with	• Sensory processing intervention: environmental modifications are not always adequate

[emm] were difficulties for [emm], he was having difficulty in order to [emm] discriminate between the movement so he had also problems with grading, what we call grading of the force and how they can, he grade, use [emm] his movements according to different activities so he needed intervention with regards to start discriminate that particular [emm] sensory, in his case the vestibular proprioceptive systems were [emm] like, really not being processed by the brain	• Sensory processing classification: discrimination-requires specific interventions
I: so is discrimination another kind of sensory profile, a problem with discrimination?	
P: yes, it's one , it's another difficulty, it can co-exist with for example poor registration	• Sensory discrimination difficulties can co-exist with hyporesponsivity
I: do you think that learning to discriminate is a necessary skill for learning to use AAC?	
P: yes, it's one , it's another difficulty, it can co-exist with for example poor registration	• Sensory processing classification: discrimination co-existing with sensory modulation disorder
P: it is a necessary skill to move around [laughs] and it is so it is, so obviously it is a necessary skill to do some thing and manipulate things around you so then obviously it's going to affect how to use an AAC device as much as it is going to affect doing other functional activities	• Sensory processing & AAC: discrimination problems impact learning to use AAC

I: So the sensory profiles we spoke about before, they are sensory modulation...and this is another type of sensory processing difficulty in the classification	
P: yes, yes, yes, yes, yes and there are others obviously like, not necessarily presenting as sensory modulation but they could be a sensory based motor problems	• Sensory processing classification: sensory modulation distinct from sensory based motor problems
I: okay. [emm] so we had 4 children in the last study and you provided sensory based interventions to all 4 of them. [emm] what happened when you did that? What was the result? Or no result?	
P: when we provided the intervention?	
I: mmm ((head nod))	
P: I think for all of them it (SB interventions combined with AAC intervention) was a very positive result. Some of them [emm] were okay by providing them strategies within the, within the clinic room, they didn't need major adaptations, they just needed adaptations to the environment and they have responded very well. Others needed a lot of intervention within the sensory motor room but we could see that this really helped to improve their attention, to be able to [emm] identify, communicate start to notice their environment much more and even were much more organised then in order to be able to cope with [emm] communicating using the device.	• Combining sensory activities with AAC interventions could be helpful • Sensory based interventions can be implemented in the AAC clinic • Environmental modifications can be implemented in tandem with AAC interventions • Amount of adaptations varies for the individual child

	• Sensory based interventions can support increased awareness of the environment • The child needs to be organised to learn to use the VOCA Environmental modifications support the child to be organised organisation to learn to use AAC
I: [emm] for those children, earlier on you mentioned that you like the idea of introducing AAC and sensory intervention together, right, [emm] are you talking about in the clinic room or in the sensory motor room…	
P: in a sensory motor room because it's easier, it's like you have the equipment, you can move the equipment, you can in- include [emm] like during the session introduce other equipment and then you can gauge according to the child and what is happening at that point in time.	• Sensory based interventions & AAC interventions can be carried out in a sensory motor room together
I: so for the 2 children that didn't go in the sensory motor room this time, would you consider that they could have gone into it?	
P: I would still maintain that they would use the device within the clinics P: hopefully we would introduce it (AAC device) into other environments	• Sensory based interventions & AAC interventions can be carried out in a clinic together

	• There is a need for AAC device use in multiple environments
I: [emm] how do you feel about a speech and language therapist implementing sensory based interventions when working with children with ASD who are learning to use AAC?	
P: can you repeat the question?	
I: how do you feel about an SLT implementing sensory based interventions when working with children with ASD who are learning to use AAC?	
P: I think if [pause] some strategies can be, one, I think for certain other things they need to be trained in use, in sensory integration obviously because it is much more complex but I've been working with other speech therapists who I've given some recommendations like I give parents and I like give, I give teachers and they can implement them during their session and they have, like, some of them, like replied back that they had success by putting in strategies but obviously when you have like children who have like, really need treatment within SI [emm] I think then [emm] they, an occupational therapist needs to be involved	• The SLT can implement some sensory based strategies • Sensory Integration must be implemented by the OT • Complex cases will require an OT • Some cases require more complex interventions
I: so, thinking to the last 4 children in the last study, can you relate that?	

P: obviously we had like 2 who I think their speech therapist, if like, given strategies they can implement it within the clinic or where they are working with but we had another 2 that they needed specialised treatment	• The SLT can implement some sensory based strategies • Sensory Integration must be implemented by OT • Some cases require more complex interventions
I: so what was different in their sensory assessments?	
P: the difference was that the other 2 that needed more intervention they had their, they had more difficulties to put it so, there was more definite difference in a lot of areas and the others were mainly only seeking behaviours, and the others had poor registration most of them and sensory discrimination. they are having the problems to communicate	• Severity related to no of areas of definite difference • Sensory seeking=less severity • Poor registration/sensory discrimination issues = more complex case=problems to communicate
I: so you think that, going back to the original question about the speech therapist implementing, that, [emm] a speech therapist may be able to implement according to the profile and the areas they have difficulty in?	
P: can you explain it better?	
I: okay, you said there that the 2 children, that, you [emm] you feel that need an OT to implement the sensory based intervention, that their profiles were more definite differences in more areas	
P: [hmm] ((nodding))	

I: so do you think that this is one of the factors that means an OT has to get involved?	
P: yes, yes, yes, probably, I think you need to do [laughing] more now [emm] like more research on this, in order to see if most of [laughing] because these are my observations but I think either we need to base it on more [emm] research so that to see if these patterns are actually correlating with children who have communication difficulties or difficulty to learn to use [emm] communication devices	
I: that brings me nicely to my next question, is there any changes that you would suggest to the study design if you were going to implement this again for 4 more children with coexisting diagnosis of ASD and sensory processing difficulty?	
P: [……] it depends on [laughing] exactly if we want to know now of certain profiles, certain sensory profiles are having communication difficulties, then obviously you need to have a group of those that have that type of, that kind of pattern versus another group, that maybe they don't have and then we'll see if both of them implement them . I'm getting mixed up	• Research needed on sensory subtypes and impact on learning to use AAC
I: so if we had to make a change to the next study what would we do?	
I: so we were talking about any changes that you would make to the study design	
P: [interrupts] yes	

I: if you were going to implement sensory based interventions again to 4 more children	
P: You need to have more children to have them graphed or put on a table in order to really see the difference and that you obviously you can maybe you do it over a large number of people in order to make it more robust and more standardised and more like [emm] obviously standardised over populations	• Research on more children with ASC and co-existing sensory processing difficulty needed
I: if we knew that, if we knew that for example certain profiles are more likely to have certain difficulties how would that help in terms of AAC do you think?	
P: I think it would help obviously because it would help, you can identify those students that would need the input of an OT together with a speech therapist. I think, that even for the speech therapist I think it would be good information that they would know hmm in these cases I think I need to work with an OT much more maybe even ask where possible to work together. If not possible maybe to see what they can do [emm] in order what they can do in their sessions by asking the OT maybe that would help them to implement AAC teaching. I think the most important thing is that you know that these children are the children that if you're not going to put sensory based interventions in place they're still going to have problems with the use of the AAC device and thus if you put sensory based	• Identification of which clinical input is required would be most beneficial • Collaboration between SLT and OT is beneficial • The OT can support the SLT • Collaboration can lead to increased time efficiency

[emm] strategies you are going to achieve [emm] learning of a device in much less time	
I: so you are referring to efficiency?	
P: yes, efficiency. I think that it might make us more effective especially ...it would be interesting to see speech therapist's perceptions on how, on teaching certain things and if they are finding it difficult and then obviously how long they think…sometimes I heard [emm] speech therapists saying they have worked on something for a long time and they haven't achieved it...then once you implement sensory based strategies you achieve it much faster	• With sensory based interventions less time could be spent teaching AAC use
I: how do you feel about working with a speech therapist, something you do everyday here?	
P: I think I have learned also myself, because obviously [emm] now I have a tool like because obviously when you are working with a child you have to communicate with him, if you don't have a system to communicate with him I think it's like doing a thing but not really gaining that relationship with the child. I think having then implemented an AAC device in the session it gives the child the opportunity to connect with the therapist much more and I think that was great because I think [emm] working with a speech therapist gave me the opportunity to see the child more holistically	• The OT needs to communicate with the child in interventions • Important for the OT to gain a relationship with the child • Connecting is important • Collaboration leads to a more holistic view of the child

I: we spoke about more children and looking at sensory profiles and how we provide intervention, do you have any other ideas for the future if we can only see 4 children? What could we do that is maybe different than last time?	
P: hmmm. I think either trying to see...to do it like an immersive like type of thing doing a sensory motor intervention with the AAC device together and see the effectiveness and then maybe compare that with not doing the sensory intervention but separately	• Future research could combine sensory room and AAC teaching
I: if we did that, we were teaching children to pick up the device, would we still do that?	
P: yeah…definitely and that they go spon-……I think something that I would love to see is that the child would go spontaneously to the device, maybe not initially, but by time that is what you want to achieve ...so going spontaneously to the device is something which yes has to be taught and it will hopefully be achieved and it should be included I think yes	• Future research could compare sensory based approaches in sensory room and not • It is important to maintain teaching moving with a device • Not all of the child's issues should be tackled together
I: so you envisage that the child wouldn't learn the whole motor action of picking up the device and giving it and reaching with it	
P: no because I think in such a session there's a lot of things he is trying to learn so my focus first is that we get the play going and the asking or the requesting or the commenting going around that, then once the child is co-	• It is necessary to break up teaching device use into smaller steps

ordinating those things so he is going to the device to ask to go again for that game or to ask more of that particular game and then this is moving on, then it will be the next step in order to teach him that he will go to the device to somebody to another person. You can't do everything at the same time.	
I: do you have any other thoughts on future research?	
P: From what I observed is my hypotheses is that certain, those children who have poor registration and or discrimination problems were the most, the children had difficulty to learn to use the AAC device, so my hypothesis is that, but obviously this needs to be confirmed. Like, is it true or is it not? if this is true this will lead us to see the importance of implementing when you're, when you're teaching children with ASD, the importance of implementing sensory strategies immediately within their sessions and while they are learning to use communication devices as well so that it would be part of the treatment so you're working on their sensory processing while implementing [emm] the AAC in the long term, so this is what we have observed but you have to see how now it is [emm] how much it gives us efficiency in children getting [emm] [emm] actually learning their AAC. Is it this way they learn the AAC fast or is it the	• Poor registration/sensory discrimination issues = more complex case=problems to communicate/learn AAC • Introducing AAC and SI early on, together • Future research: is combining sensory based interventions and AAC intervention efficient?

way we're doing it normally? How does it compare?	
I: okay. [emm] so are you saying that you think that the AAC teaching needs to be combined	
P: [interrupts] yes	
I: with intervention that targets the sensory processing difficulty?	
P: [yes] because I've seen an import-, first of all we know research let's start from there we know research that when you [emm] stimulate the vestibular system you are also stimulating like [emm] the area let's say of the vocals and etcetera so I don't know that link into communication but obviously [emm] like what I've seen is that when you give movement to children they are much more ready to communicate with you so that's why I see the importance of implementing and teaching an AAC system [emm] into such a situation.	• Sensory based interventions promote communication
I: so are we talking that one professional could do this?	
P: Probably I think it would be best to have 2 professionals doing it together so that the session is being run by 2 therapists. You have the OT who is [emm] obviously putting up the equipment and working with the child and then the speech therapist who's seeing the opportunities in order and seeing which language they need and which words are important in order to be taught.	• Clinical roles still need defining during collaborations between OT and SLT

I: okay. And your own professional background?	
P: so, [emm] I have a degree in occupational therapy and I have also a masters in inclusive education and communities. I've been working in the area of paediatrics for now [emm] 12 years and I have done also courses on [emm] sensory processing and [emm] in that area. It's not sensory integration [emm] which hopefully I will be starting soon but it's like a course on [emm] sensory processing and praxis and [emm] postural skills.	
I: is there anything else that you expected me to ask you about?	
P: No	
I: is there anything else you want to add about your involvement so far in this project?	
P: it was a nice experience actually [laughing]	
I: why was it a nice experience?	
P: because obviously I, because actually [emm] I've been observing certain things through my practice but then when you see it really working and you see the children really then communicating much much then you see it again you see it even [emm] being [emm] tabulated then obviously it will strengthen your observations and it gives you more thoughts and more [emm] questions to answer and find research or do research about	
I: what kind of things had you seen in your practice? That this has linked to for you?	

P: actually that I have referred to it, that whenever I use, like I have like parents coming to me and telling me that the child does not speak or the child does not use the device automatically when in a speech therapy session but in your session he does use it because I am, I'm playing and they are at ease and they are having fun the children and they actually , those who are able to verbalise they would verbalise and those who are able to use a device will want to use the device in order to continue the process of play and to maintain what they are liking about that particular play, for example if they want to bounce on the ball or jump on the trampoline they are going to tell you more of that.	• Intervention environment: Need for play, be at ease, fun = more communication • Fun creates motivation
I: I just wanna go back to [emm] changes to study design, we used 2 displays in the last study, do you have any thoughts on that?	
P: the grid versus the visual scene?	
I: yes	
P: since I don't, since I don't think it's (the displays) the most important thing the problems that were, that were affecting the child in order to learn or to use the device is because it was being interfered by the need to [emm] get the sensory input so either because [emm] they were going to communicate and suddenly they are, they lose attention or they need to go and press something or to get, or jump so it was being like cut off so that the	• The device display is not important • Sensory based interventions can support learning AAC • Sensory issues affect learning to use AAC • Communication and sensory state are linked

process of communication couldn't be [emm] fluent. But this was improved once we gave them the sensory input because then communication started to be fluent	

Study 3: OT interview- Data coded for 167 codes

1. Intervention strategies are numerous
2. Not all children require the same intervention strategies
3. Necessity of sensory based intervention to learn AAC
4. Severity of sensory processing impacts on learning AAC use
5. Organising the self is important to learn AAC
6. Severe sensory processing issues require sensory based input
7. Body awareness is important to learn AAC use
8. Structured teaching is important
9. Behaviourist strategies are used
10. Task analysis is needed
11. Different environments are needed for teaching AAC
12. Different objects are needed in the intervention process
13. Task analysis is used in the AAC intervention
14. Matching teaching procedure to child's needs
15. Teaching AAC use needs to specific to the child
16. Matching environment to child's sensory needs is important
17. Environment adaptations support making the AAC device as easy to use as possible
18. It is important to create the need to communicate
19. Creating opportunities to communicate is important
20. Combining sensory activities with AAC intervention
21. Positive effect of combining sensory activity with AAC intervention
22. Movement can improve motor access to AAC device
23. Using motivators/rewards is a strategy in AAC interventions
24. Vocabulary choices should reflect child's likes
25. Environmental modifications can improve attention
26. Disorganisation is negative
27. Organisation is important strategy

28. Schedules are helpful during AAC interventions
29. There needs to be flexibility in therapeutic approach
30. Adapting therapeutic self to child is needed
31. Sensory based strategy- low arousal-therapist adaptation in communication
32. Adapting self in sensory based interventions
33. Sensory based strategy- high arousal-therapist adaptation of communication
34. Energy levels: sensory based intervention-therapist adaptation to child's level
35. Opinion of displays: no difference
36. Displays: grid is better
37. Grid might be better for children with visual scanning issues
38. Display did not impact on whether criterion was achieved
39. Achieving criterion is linked to sensory state
40. Child disorganisation affects learning to use AAC
41. Sensory state can have an impact on learning AAC device use
42. Need movement patterns to learn to use AAC
43. Sensory state can negatively impact ability to communicate
44. Combining sensory activities with AAC intervention could be helpful
45. Sensory motor issues can exist in children with ASD
46. Sensory motor skills are linked to co-ordination and accuracy of motor movements
47. Sensory motor skills issues can affect access on the device
48. Improving motor skills leads to learning to use the AAC device
49. AAC intervention: follow child's lead combined with sensory intervention supports forming a connection
50. Nonverbal communication improves during sensory based interventions
51. AAC intervention: setting the scene using sensory based interventions supports provides motivation for communication/interaction
52. Sensory based interventions can give children a reason to communicate
53. Creating motivation is important

54. It is possible to go beyond teaching requesting with AAC devices
55. Sensory processing issues & learning to use an AAC device are linked
56. ASC is linked to motor issues
57. Motor issues can impact a child's ability to carry out functional activities
58. ASC & sensory processing issues impact learning to use AAC device
59. AAC device requires use of the body
60. Sensory processing issues impact motor skills
61. Relationship between sensory processing issues and motor issues is intertwined
62. Motor skills required to learn AAC
63. Sensory processing issues impact learning AAC device use
64. Sensory processing issues can impact attention,
65. Sensory organisation supports eye hand co-ordination,
66. Sensory organisation supports visual attention
67. There is a link between sensory based interventions and talking
68. Sensory processing supports nonverbal skills
69. Sensory input supports the ability to connect
70. Being able to connect supports communication
71. Timing of sensory processing input can be before AAC input
72. Sensory processing issues & ASC: varies in prevalence
73. Sensory processing issues & ASC: varies in severity
74. Severity of sensory processing issues is linked to communication
75. Timing of sensory processing input can be with AAC input
76. Sensory processing input & AAC intervention: location could be a sensory motor room
77. Sensory based interventions involve play
78. Sensory based interventions involve communication
79. Play provides opportunities in sensory based interventions for AAC intervention
80. Sensory based interventions provide opportunities for teaching AAC device use

81. AAC intervention strategies for children who don't have sensory processing issues: behaviourist strategies, modelling, fading
82. Children who don't have sensory issues learn faster, no need for OT input
83. Definition of severe sensory processing issue is when all sensory processes are affected
84. Informal assessments are used to assess sensory processing
85. Formal assessments are used to assess sensory processing
86. Parental interviews are used to assess sensory processing
87. Information from assessments is integrated
88. Assessment results are used to plan intervention
89. Environmental modifications are a type of sensory based intervention
90. A sensory motor room can be used for sensory based interventions
91. The adaptive response is the goal of sensory based interventions
92. Goal setting includes sub goals
93. Communication plays an important role in forming a therapeutic relationship in sensory based interventions
94. The just right challenge is a goal of sensory based interventions
95. Discrimination skills are a part of sensory processing
96. Discrimination needs to be targeted if there is a problem
97. Sensitivities are a part of sensory processing
98. Sensitivities need to be worked on if there is a problem
99. Environmental modifications can take different forms
100. Sensory based interventions can be embedded within AAC sessions
101. Movement goals can be set as part of sensory based interventions
102. Sensory based interventions include environmental modifications
103. Sensory processing intervention involves the just right challenge
104. Being at the 'just right' level is needed for attention
105. Sensory processing system includes proprioception
106. Sensory processing system includes the vestibular system
107. Sensory processing system: 5 sensory systems apart from vestibular and proprioceptive systems

108. Sensory processing classification: sensitivities
109. Some children have oral sensitivities
110. Sensory processing classification: hyper-reactive
111. Some children have tactile sensitivities
112. Sensory processing classification: separate or coexistence of different profiles
113. Sensory processing classification: hypo-reactive
114. Sensory processing classification: sensory seeking
115. Sensory processing classification: sensory avoiding
116. Treatment is planned to restore sensory processing as a result of assessments
117. Sensory processing: goal of treatment is to balance sensory systems
118. Sensory processing intervention: environmental modifications are not always adequate
119. Sensory processing discrimination issues require specific interventions
120. Sensory discrimination difficulties can co-exist with hypo-reactive
121. Sensory processing classification: discrimination co-existing with sensory modulation disorder
122. Sensory processing & AAC: discrimination problems impact learning to use AAC
123. Sensory processing classification: sensory modulation distinct from sensory based motor problems
124. Sensory based interventions can be implemented in the AAC clinic
125. Environmental modifications can be implemented in tandem with AAC interventions
126. Amount of adaptations varies for the individual child
127. Sensory based interventions can support increased awareness of the environment
128. The child needs to be organised to learn to use the VOCA
129. Environmental modifications supports the child to be organised

130. Sensory based interventions & AAC interventions can be carried out in a sensory motor room together
131. Sensory based interventions & AAC interventions can be carried out in a clinic room together
132. There is a need for AAC device use in multiple environments
133. The SLT can implement some sensory based strategies
134. Sensory Integration must be implemented by OT
135. Complex cases will require an OT
136. Some cases require more complex interventions
137. Severity related to no of areas of definite difference
138. Sensory seeking=less severity
139. Poor registration/sensory discrimination issues = more complex case=problems to communicate
140. Research needed on sensory subtypes and impact on learning to use AAC
141. Research on more children with ASC and co-existing sensory processing disorder needed
142. Identification of which clinical input is required would be most beneficial
143. SLT benefits from OT input
144. Collaboration between SLT and OT is beneficial
145. The OT can support the SLT
146. Collaboration can lead to increased time efficiency
147. With sensory based interventions less time could be spent teaching AAC use
148. The OT needs to communicate with the child in interventions
149. Important for the OT to gain a relationship with the child
150. Connecting is important
151. Collaboration between professionals leads to a more holistic view of the child
152. Future research could combine sensory room and AAC teaching

153. Future research could compare sensory based approaches in the sensory room and not
154. It Is important to maintain teaching moving with a device
155. Not all of the child's issues should be tackled together
156. It is necessary to break up teaching device use into smaller steps
157. Poor registration/sensory discrimination issues = more complex case=problems to communicate/learn AAC
158. Introducing AAC and SI early on, together
159. Future research: is combining sensory based interventions and AAC intervention efficient?
160. Sensory based interventions promote communication
161. Clinical roles still need defining during collaborations between OT and SLT
162. Intervention environment: Need for play, be at ease, fun = more communication
163. Fun creates motivation
164. The AAC display is not important
165. Sensory issues affect learning to use AAC
166. Communication and sensory state are linked
167. Sensory based interventions can support learning AAC

Study 3: OT interview-Stage 2 coding

Initial codes	Subthemes
• Need movement patterns to learn to use AAC • AAC device requires use of the body • Sensory processing issues impact learning AAC device learning • Sensory processing issues can impact attention • The child needs to be organised to learn to use the VOCA • Sensory organisation supports eye hand co-ordination, • Sensory organisation supports visual attention • Improving motor skills leads to learning to use the AAC device • Sensory processing & AAC: discrimination problems impact learning to use AAC • Being at the 'just right' level is needed for attention • Body awareness is important to learn AAC use • Motor skills required to learn AAC • ASC & sensory processing issues impact learning to use AAC device negatively • Sensory state can have an impact on learning AAC device use • Sensory issues affect learning to use AAC	• *Sensory processing has a relationship with learning to use an AAC system*

• Opinion of displays: no difference • The AAC display is not important • Displays: grid is better • Grid might be better for children with visual scanning issues • Display did not impact on whether criterion was achieved	• *AAC device display decisions*
• It is possible to go beyond teaching requesting with AAC devices	• *Communicative functions*
• Structured teaching is important • Behaviourist strategies are used • Different objects are needed in the intervention process • Task analysis is used in the AAC intervention • Task analysis is needed • It is important to create the need to communicate • Creating opportunities to communicate is important • Using motivators/rewards is a strategy in AAC interventions • Disorganisation is negative • Organisation is important strategy • Schedules are helpful during AAC interventions • There needs to be flexibility in therapeutic approach • AAC intervention: follow child's lead combined with sensory intervention supports forming a connection • Creating motivation is important	• *AAC intervention strategies*

• AAC intervention strategies for children who don't have sensory processing issues: behaviourist strategies, modelling, fading • Different environments are needed for teaching AAC • There is a need for AAC device use in multiple environments • Intervention environment: Need for play, be at ease, fun = more communication	
• Connecting is important • Sensory input supports the ability to connect • Being able to connect supports communication • Important for the OT to gain a relationship with the child • Sensory based interventions can give children a reason to communicate • Sensory based interventions promote communication • Communication plays an important role in forming a therapeutic relationship in sensory based interventions • AAC intervention: follow child's lead combined with sensory intervention supports forming a connection • The OT needs to communicate with the child in interventions • Sensory based interventions involve communication	• *The importance of bonding*
• Adapting therapeutic self to child is needed • Communication and sensory state are linked	• *Child-clinician bond is dependent on*

• Poor registration/sensory discrimination issues = more complex case=problems to communicate/learn AAC • Severity of sensory processing issues is linked to communication	*individual characteristics*
• Informal assessments are used to assess sensory processing • Formal assessments are used to assess sensory processing • Parental interviews are used to assess sensory processing • Information from assessments is integrated • Assessment results are used to plan intervention	• *Assessments of sensory processing patterns underlie interventions*
• Treatment is planned to restore sensory processing as a result of assessments • Sensory processing: goal of treatment is to balance sensory systems • Goal setting includes sub goals • Sensory processing intervention involves the just right challenge • The just right challenge is a goal of sensory based interventions • The adaptive response is the goal of sensory based interventions • Sensory based interventions include environmental modifications • Environmental modifications are a type of sensory based intervention • Environmental modifications can take different forms	• *Sensory processing interventions are goal driven*

• Environmental modifications support the child to be organised • Sensory processing intervention: environmental modifications are not always adequate • Movement goals can be set as part of sensory based interventions • Movement can improve motor access to AAC device • A sensory motor room can be used for sensory based interventions • Sensory processing discrimination issues require specific interventions • Severe sensory processing issues require sensory based input • Sensory Integration must be implemented by OT • Sensory based interventions involve play	
• Children who don't have sensory issues learn faster, no need for OT input • Sensory motor issues can exist in children with ASD • Severity related to no of areas of definite difference • Definition of severe sensory processing issue is when all sensory processes are affected • Sensory seeking=less severity • Sensory processing system includes proprioception	• *Sensory processing difficulties are individual*

• Sensory processing system includes the vestibular system • Sensory processing system: 5 sensory systems apart from vestibular and proprioceptive systems • Sensory processing classification: sensitivities • Sensitivities are a part of sensory processing • Some children have oral sensitivities • Some children have tactile sensitivities • Sensory processing classification: hyper-reactive • Sensory processing classification: hypo-reactive • Sensory processing classification: sensory seeking • Sensory processing classification: sensory avoiding • Sensory processing classification: sensory modulation distinct from sensory based motor problems • Discrimination skills are a part of sensory processing • Discrimination needs to be targeted if there is a problem • Sensory discrimination difficulties can co-exist with hypo-reactive • Sensory processing classification: discrimination co-existing with sensory modulation disorder	

Sensory processing classification: separate or coexistence of different profiles	
• Intervention strategies are numerous • Not all children require the same intervention strategies • AAC intervention strategies for children who don't have sensory processing issues: behaviourist strategies, modelling, fading • Not all of the child's issues should be tackled together • It is necessary to break up teaching device use into smaller steps • Teaching AAC use needs to specific to the child • Matching teaching procedure to child's needs • Vocabulary choices should reflect child's likes	• *AAC interventions are individualised*
• Sensory processing issues & learning to use an AAC device are linked • Sensory processing & AAC: discrimination problems impact learning to use AAC • Severity of sensory processing disorder impacts on learning AAC use • Child disorganisation affects learning to use AAC • Necessity of sensory based intervention to learn AAC • Combining sensory activities with AAC intervention could be helpful	• *AAC interventions could be combined with sensory processing interventions*

• Positive effect of combining sensory activity with AAC intervention • Achieving criterion is linked to sensory state • Combining sensory activities with AAC intervention • Sensory based interventions provide opportunities for teaching AAC device use • Environment adaptations support making the AAC device as easy to use as possible • Play provides opportunities in sensory based interventions for AAC intervention • AAC intervention: setting the scene using sensory based interventions supports provides motivation for communication/interaction • Sensory based interventions can support learning AAC • With sensory based interventions less time could be spent teaching AAC use • Sensory processing supports nonverbal skills • There is a link between sensory based interventions and talking • AAC intervention: setting the scene using sensory based interventions provides motivation for communication/interaction • Play opportunities in sensory based interventions can support AAC intervention • Nonverbal communication improves during sensory based interventions • Impact of sensory state on ability to communicate	

• Poor registration/sensory discrimination issues = more complex case=problems to communicate	
• Identification of which clinical input is required would be most beneficial • SLT benefits from OT input • Collaboration between SLT and OT is beneficial • The OT can support the SLT • Introducing AAC and SI early on, together • Collaboration can lead to increased time efficiency • Clinical roles still need defining during collaborations between OT and SLT • Collaboration between professionals leads to a more holistic view of the child	• *Collaboration between professionals*
• The SLT can implement some sensory based strategies • Sensory based interventions can be implemented in the AAC clinic • Complex cases will require an OT • Amount of adaptations varies for the individual child • Some cases require more complex interventions	• *Sensory processing interventions are individualised*
• Research needed on sensory subtypes and impact on learning to use AAC • Research on more children with ASC and co-existing sensory processing disorder needed	• *Understanding the impact of sensory processing difficulties on learning to use AAC*

• Future research could combine sensory room and AAC teaching • Future research: is combining sensory based interventions and AAC intervention efficient? • Timing of sensory processing input can be before AAC input • Timing of sensory processing input can be with AAC input • Sensory based interventions & AAC interventions can be carried out in a sensory motor room together • Sensory based interventions & AAC interventions can be carried out in a clinic room together • Environmental modifications can be implemented in tandem with AAC interventions • Sensory based interventions can be embedded within AAC sessions • Sensory processing input & AAC intervention: location could be a sensory motor room • Future research could compare sensory based approaches in the sensory room and not	• *Collaborating to improve AAC outcomes*

Themes and subthemes (where evident) for the final thematic network

Theme 1: Heterogeneity requires individualisation of interventions

Subthemes
1. *AAC interventions* • *AAC interventions are individualised* • *Communicative functions* • *AAC intervention strategies* • *AAC device display decisions* 2. *Sensory processing interventions* • *Assessment and interventions of sensory processing* • *Sensory processing difficulties are individual* • *Assessments of sensory processing patterns underlie interventions* • *Sensory processing interventions are individualised* • *Sensory processing interventions are goal driven* • *Impact of sensory processing difficulties on learning to use AAC*

Theme 2: Child-clinician bonds are important

Theme 3: Ways to improve AAC intervention outcomes

Subthemes
1. *Understanding the impact of sensory processing difficulties on learning to use AAC* 2. *Collaborating to improve AAC outcomes* • *AAC interventions could be combined with sensory processing interventions* • *Collaboration between professionals*

Appendix 15

Study 4: Transcript and coding of qualitative responses from Social Validity Questionnaire: Part 2

- *What were some benefits of the intervention sessions?*

  Noah's mother: he is communicating more with us, decreased frustration. Not getting so many meltdowns. He is asking for things more using pointing at home. He is more focused. His eye contact has improved and he is playing with proper toys like a trainset and cars and he is exploring them.

  James' mother: He was staying a bit longer with each toy. He still made some play choices even if it was sensory.

  Lee's mother: Lee learnt to ask for something by clicking on the picture on the tablet. He learnt to use the tablet without being prompted to do it. He realised that if he used the tablet he could get what he wants.

  Max's mother: The sessions showed that he knew what he had to do, you were persistent with him so if he didn't do what you wanted he didn't get it. I see him understanding more, following instructions at home, school, with his dad.

- *Did you notice any changes in the communication of the child? What kind?*

  Noah's mother: I hear him say different sounds like 'e' and they have different pitches. He seems more aware of others too. I saw him combining the sounds he is making with reaching

  Noah's father: He looks at me when he asked for what he wants

  James' mother: I noticed he is interacting with his cousin…now he knows it's 'more'. Now he's worked it out. His social development has improved. He said 'no' after I said it. There was some decrease in frustration. He is waiting longer too. Looks at it but will wait. If I told him 'wait' before, he wanted it immediately.

Lee's mother: He is now asking when he needs you. It's use of the tablet for what he wants not to interact with you though. I think if we did this at home there would be more progress.
Max's mother: He is interacting more with other children, allowing his sister in a little.

- *Please add anything you would like to say about how your child progressed in the study*
  Noah's mother: Maybe he might get lazy to speak. Instead of saying the word he might press but it's better he has a system of communication. If he can't communicate he might have a meltdown. It will be challenging to teach him to use the system, I will have to move things out of reach
  Noah's father: he's playing with others at school, he's looking for them. He seems to be moving on from the infantile stage. Now he's jumping the steps, trying to build the blocks, he has strength in his body
  James' mother: How will I deal with saying 'no' if he wants something? I usually give in. There are lots of distractions at home. He might become dependent on the device and not talk but I know there will be less frustration. I think I can help James to use a device at home cos once he is shown something and if it's within his potential and he feels it's advantageous I'm sure he can learn it. I'm hoping he will learn how to use a high tech AAC device to decrease his frustration.
  Lee's mother: It's something that has to be done, otherwise you won't get there. It should not be considered part of the work to be done at home. I would like to do this at home, school. There would be a continuation. I believe if it's done regularly and more times a day he would learn it. I think it works, he needs movement to concentrate.
  Max's mother: I'm afraid it will make him lazy to talk. I hope he learns to use it to 'talk' not to play. I want to try this, if it will help him to be less frustrated, yes, for him and for us, for everyone. In the long term it will save time because I will know faster what he wants. He will be calmer.

Study 4: From potential subthemes to subthemes to themes

Potential Subthemes	*Subtheme*	*Theme*
1. Communication has increased with VOCA intervention	*Impact on communication*	Benefits of teaching the child to request with the VOCA
2. There is increased requesting using gestures with intervention		
3. There is increased requesting using the VOCA with intervention		
4. Learning to use the VOCA had a positive impact on non-verbal communication including pointing and eye contact		
5. Choice making skills have emerged		
6. There is improved comprehension		
7. Attention skills have improved		

8. Learning to use the VOCA has resulted in more speech sounds	*Impact on speech*	
9. Imitation of speech is emerging		
10. Learning to use a VOCA had a positive impact as the child is now showing greater interest in other people	*Impact on socialisation*	
11. Play has improved since VOCA intervention began		
12. Learning to use the VOCA had a positive impact on the child's behaviour	*Impact on behaviour*	
13. My child is less frustrated when he uses the VOCA		
14. There was improvement in my child's motor skills	*Impact on motor skills*	
15. Movement supports learning		
16. The clinicians were persistent	*Persistence*	Implementing AAC interventions
17. Changes to the home environment are needed to teach VOCA use	*Environment*	
18. AAC interventions need to be implemented in all environments		
19. My child can learn	*Positive mindset*	
20. Parents should implement AAC interventions	*Who should implement AAC interventions*	

21. Use of an AAC system could have a negative impact on speech development	*Fears about AAC systems*	Feelings towards VOCAs
22. It could be challenging to teach the AAC system		
23. The VOCA could end up being used for play		
24. Learning to request with a VOCA is not necessarily social interaction		
25. My child needs a VOCA	*Acceptance*	
26. Difficulty in communication can result in challenging behaviour		
27. Desire for their children to learn to use the VOCA		
28. Parents keen to start implementing a VOCA with their children		

Appendix 16

Study 4: Focus group transcript

Date of recording: 13/03/2018

Present: Moderator: Female OT and university lecturer with 20 years clinical experience

Assistant moderator: Lead researcher

Participants (Pseudonyms): Andy (male OT)

Jo (female SLT)

Meg (female SLT)

Languages involved: English with occasional interjections in Maltese

Transcriber: Lead researcher

Date of transcription: 01/04/2018 to 15/04/2018

Moderator: Let's start with the first question, so can you tell me a little about your professional backgrounds?

Andy: I'm an occupational therapist, been working as an occupational therapist at ACTU for the last year, I worked mainly, apart from my university studies with children, so I'm directing towards that expertise. I'm also doing a masters in humanitarian action so basically dealing with humanitarian crisis focusing on children coming from a migrant background and inclusion in education

Jo: I'm a speech therapist. I've been working at ACTU since er July. Emmmmm, I've had (.) during my placements I've had some experience a little bit with adults but mostly with children so I must say I feel a bit more confident (.) mmm (.) working with children (.) uuuum (.) ((laughs))

Moderator: Anything else related? Anything else maybe that

Jo: Not really ((laughs))

Moderator: Alright

Meg: I'm a speech therapist as well. I graduated in 2012. I've been working in ACTU since March 2017, close to a year now, March 20th will be a year. Mostly placement I had quite a varied placement, I had geriatric placement but mostly

children, preference? I prefer the paediatric side of it. Emmmmm with regards to placement with AAC I did not have that much exposure, emmmmm, but I think ACTU it helped me grow my knowledge a lot of aac and also the cases we have (.) I work with Andy and my knowledge grows as well on that aspect depending on the cases we have

Moderator: OK…alright, OK so let's continue with the second question, so think back to the last time you were working with a child with ASD, OK, how did you establish a connection with the child?

Andy: I've experienced different scenarios when it comes to children with ASD, I've experienced children where you can quickly establish yourself with the child, in his little circle, where you go in very quickly, some children do let you in very quickly, I mean that's what I feel, then I can think of a particular child where it took us almost 8-9 months of regular intervention with the child to actually finally get some eye contact and actually get into his circle and you can feel that you're there, that's he's there with you and you can start doing something, a very good 8-9 months I think

Jo: And I think, mainly as well to add on to what Andy said, I think what I found from my experience at ACTU is, emmmmm, apart from trying obviously to get into the child's circle is maybe, more like taking the child's lead, and I think that's that's something which I found very helpful, if you keep that in mind, I think when you are with children, taking the child's lead (.) and then moving on from there, so I found that quite helpful

Meg: Similar to what the others said, I mean I feel autism is a very very vast spectrum emmmmm sometimes you have a child who comes in the clinic and you feel they connected easily with you, even the reinforcers you use, you feel you click on that level with them but sometimes it requires more work from your end to kind of set the boundaries of the relationship between you and make the child feel comfortable so he can trust you and I think the element of trust and comfort plays a big role in the relationship between you and the child, I mean sometimes children with autism lack eye contact and facial expressions but sometimes they show you in other ways relating (.) they take your hand direct

you to what they want. In a way you can still emmmm read what they want to tell you and you can feel a connection
Andy: Although it might sound superficial sometimes even trial and error, you try something with a child and you say OK, I'm nowhere close to
Meg: Sometimes what works with one child won't work with another
Andy: YES! Sometimes you might say OK, his parents might tell you he's very technologically inclined, so you say OK, using technology to get into his circle but then you use technology and it becomes his only thing and he blocks you out because of the computer. Then you say OK so next time let's keep the computer switched off and try something else, trial and error one session after the other, and then it's like, OK, here we've got something, he likes bubbles, OK so let's, we have something, let's work on this
Moderator: Using what the child likes
Meg: And sometimes I feel, you have a child, you try everything and nothing works, and you say what am I doing wrong? Is it the room? The new place? The toys? Is it me? Emmmmm but then he comes to the next session, first he's crying and then he calms down, then he's smiling at you, he takes off his jacket, he shows you that he's comfortable, he approaches you, he starts looking and exploring
Andy: And you say, is this the same child? What happened during these two weeks?
Moderator: Is there anything that you feel, maybe that you use, any particular techniques or maybe even objects that maybe you feel enhance the connection with the child?
Andy: We involve the family a lot, and we ask in the school and the home environment what really motivates the child to connect with the child
Moderator: More specifically about connecting with the child, is there anything in particular maybe that you did, in particular, I don't know (.) ehm, as I said it could be something you use or maybe your own natural way that you dealt with the child?

Meg: I think it's very important, the way you approach the child, not making him feel intrusive and also the tone of voice plays a very important role I feel
Moderator: OK
Meg: The way you give instructions to the child, you can give him the liberty to make choices but at the same time you need to say listen, we're going to do this and this
Jo: I think using techniques like observe, wait and listen
Meg: Following the child's lead
Jo: Yes (.) as Meg said, providing choices I think it's very very important
Andy: I like to look at it from a fun point of view
Meg: Ehe (Maltese: indicates agreement)
Moderator: OK
Andy: Cos sometimes when children feel you put too many demands on them they see you as as a (.) like a test or at school. Most of the time we try to approach through a fun kind of approach, if it's a motor sensory activity, if it's emmm working or any components that we are trying to work on we try to find a fun tweak to it, to get to him, I mean in my experience, it seems to work more than sitting down and this this this, and schedules and very rigid intrusive kind of approach
Jo: I think even the toys we provide them with, I mean we try to find toys which they like, that are very stimulating
Meg: But sometimes you, we need to bargain sort of and provide rewards, let's do one last one and then you can do what you want, the drums or the blocks or whatever emmmmm
Moderator: So like multiple
Meg: YES
Moderator: Is there anything else you would add to this?
Andy: Environment as well, you might realise that a particular environment is just not working for the child, and so you might say let's try something else, let's try school, let's try home to get into, maybe you know in that particular moment you as a new person or the therapist and people in the room, the whole

environment thing it's too much for him, you might say OK, we need to do something drastic, let's change the environment
Moderator: Alright, so you were asked to observe the interactions between therapists and children, can you tell me about your observations?
Andy: One main thing that I observed is that how quickly a therapist can shift from one technique to the other
Meg: Flexibility, you're saying?
Andy: Very much
Jo: Ehe (Maltese: indicates agreement), in terms of being flexible I saw that very much, I mean in one instance they are using one technique and then you know you see the child is responding in a certain way and OK, then they have to change it, and you know, according to how the child is responding, so yes I agree with Andy
Andy: Even the prompt hierarchy
Jo: Ehe (Maltese: indicates agreement) the prompts, exactly
Andy: Going up and down all throughout the session
Jo: They're always either providing a bit more prompting and then like backward chaining, they're pulling away slowly slowly
Andy: At same time
Meg: It's like what they're saying, everything was structured, they did the same activities with different the children but their approach varied according to the child, with one child there was less prompting, with another there was more, depending on how the child presented during the session, flexibility, the spontaneity as well, sometimes they had children who came in the clinic, and I don't know, were frustrated on the day they had to come up with something
Jo: Uummmm (agreement)
Meg: That was, it was very nice to observe as well
Moderator: OK, alright, good, emmmmm, how do you think the therapists' nonverbal communication affected the interactions?
Andy: Very much
Meg: Very much

Andy: Cos it was, it was actually their key thing of getting the child to where you want. I think the whole scope of the session the goal was pretty much defined, pretty straightforward so all the kids came there for one specific goal, we all knew it and you could feel it in the session that, that is the ultimate goal of all of this but then, to get to it, I mean using from physically guiding the child to lessening your prompt to visually pointing towards something else, it was impressive, I mean, the child was guided throughout from starting to the goal
Moderator: What aspects of nonverbal communication?
Meg: I think, I noticed the face
Jo: A lot, and the tone of voice
Meg: Eyes
Jo: I noticed it almost in every session, the tone of voice when they are using a reward (.) whooooo [with exaggerated intonation], it was like (.) you know (.) kind of trying to get him (.) and even on one occasion when they were for example it was a bubble popping activity, emm, there was lots of wow [with exaggerated intonation]. You know, I think that helped the child to even you know, get him into the activity even more, so that I observed it, almost I think every session
Meg: I remember lots of use of facial expressions, exaggerated facial expressions (.) emmm looking as well I remember emmm one instance they had a child who was wanting something different and the therapist looked in the same direction to kind of connect with the child and experience the same thing the child was looking at in that instance. And also, I remember (.) there were instances where the therapists were setting boundaries emmm (.) physically (.) I mean not using verbal instruction but they were blocking the table or or part of the room for the child not to escape but by their physical
Andy: Even where you place yourself (.) how close to the child which level, at which height, sitting down if the child is just refusing to do an activity at the table and he sits down on the floor, physically positioning yourself on the floor in front of him

Jo: Yes (.) for example most of the time like A said they leaned towards the child, they were crouching, what I noticed as well was the open hand gesture for example they would do this [shows with own hands] (.) they're expecting, and even the body language
Meg: Similar to what you're saying at some points they would stare at the child and wait
Jo: Exactly
Meg: They're looking at the child expectantly
Jo: Waiting
Meg: With an expectant look
Jo: Ehe (Maltese: indicates agreement)
Meg: For a gesture, a verbalisation, sometimes I feel during clinics we want to say a lot and we don't give time for the child to do much
Jo: We overload them
Meg: And they were waiting and taking the child's lead and they were really observing and waiting for the child to initiate, giving them time
Moderator: OK
Meg: Not with all of them, but with some
Moderator: anything else?
Jo: Emmm I noticed as well the way they changed their voice, for example, on one particular occasion, we had a, one of the children was feeling quite low and the tone of voice was more, like, you, know, alerting so (.) and even calling his name (.) for example (.) before (.) you know trying to get him to do something, emmmm (.) yes I noticed the use of touch
Meg: And physical (.) hekk (Maltese: translates 'that way') touch was being used to alert or to calm down or to redirect sometimes when they were saying a verbal instruction and it wasn't being understood by the child they used to take his hand for example and direct him to where they wanted the child to go, to what they wanted him to do

Andy: Some nonverbal communication was used in other ways (.) when you want to ignore something, when you want to correct a behaviour by ignoring a behaviour for example
Moderator: OK
Andy: Child was pinching, you ignore that, he might try to bite you and you try to ignore that ((laughs)). Nonverbal communication, it's not, the way I've seen, it's not always to emmmm push towards to something else, to correct from the other side
Moderator: OK
Andy: It's quite interesting to see that
Meg: There were lots of pointing as well
Jo: Pointing, even while giving verbal commands, for example, if they tell them (.) on one occasion they told them for example sit down on the chair, point, even when, I remember on one occasion (.) errrr (.).the child was trying to vocalize 'mama' and they told him 'yes, look, mummy'
Moderator: OK
Meg: There was a total communication approach as well
Jo: Exactly
Meg: So there were gestures, materials, verbal cues, there was a lot going on
Moderator: OK, good, anything else?
Andy: When it comes to nonverbal?
Moderator: What about the verbal, how do you, what did you observe in terms of how the therapists communicated verbally?
Andy: Verbal, I think it was used a lot to calm a child who is on the go, so the way you put words, short, direct, loud instructions to get the child with you. Soft voice to get that joint attention, get the child involved with you
Jo: Verbal reinforcement I noticed as well
Meg: Positive reinforcement
Jo: Positive reinforcement yes, emmmm, also saying, for example if the child is making a request (.) emmmmm (.) he requested ball usually the therapists

would say 'ball', they would continue and repeat the word and I noticed that every session actually
Meg: Short instructions and to the point
Jo: Choose. literally CHOOSE
Meg: 'Go there' 'do this' (.) emmm (.) and also they were expanding on what the child was saying at some points the child said 'ball', ah, 'you want ball' or 'red ball'
Jo: 'Yes, you've got the ball' for example
Meg: 'You've got the ball', there was a lot of encouragement as well going on 'you can do it, you did it, you're nearly there' emmmm 'go on' there was a lot of this
Moderator: Alright
Andy: Verbally, they also were working on different things at the same time, introducing things such as 'it's my turn, your turn' , getting the child on board with changing the activity and moving on to something else, so verbally they were guiding the child a lot towards what they wanted him to do
Moderator: OK, anything else in terms of verbal communication?
Andy: They introduced, like, the negative aspect
Meg: I remember
Andy: For example he was pressing 'juice' and the child had no juice 'no juice' so they were like, using verbal communication to indicate negation 'no this' that was quite nice to see
Meg: And I remember with some children (.) emmmm (.) they wanted more (.) and they were creating communication opportunities as they go along, I mean e.g., a puzzle activity and they were sabotaging the activity to create communication opportunities, for example, taking the puzzle pieces so the child can ask for more and encouraging the child 'you can tell me, you can ask for more' (.) emmm (.) and sabotage I think they were using as well a lot
Moderator: Right, OK
Andy: Verbal cues that were going on (.) they were not consistent, it depends on the child's performance, the time in the activity cos then there might be an

activity where he likes it or a session where he feels less frustrated and then he just keeps on going, you can use nonverbal communication, just guide him to where you want so verbal and nonverbal communication were very much intertwined and depends on the child's performance in that particular time
Meg: And I think at some points they were also highlighting what the child was doing, for example, 'good asking'
Jo: That's good, always labelling, they didn't just repeat if the child requested ball, 'ah, ok, ball' 'you want ball or yoghurt' not just labelling it, emmmmmm (.) literally anything that the child is going to ask for that I noticed
Andy: Verbally they were also attentive to the language of the child, some children were Maltese speaking and some children were English speaking
Moderator: Ehuummmmm (agreement)
Andy: So therapists were making an emphasis that if, you get carried away quickly especially if you have one session after the other, if you're speaking in English, but then they were very alert (.) this is a Maltese speaking child so instructions and commands should be in Maltese and that is very important to keep in mind as well
Moderator: OK, anything else?
Meg: I don't know if we mentioned this but the way the instructions were being given sometimes they were loud and assertive, sometimes they were soft and mellow, and calm depending on the child's feeling. If the child was on the go and active the tone tended to be more calm but when the child was really passive then the tone tended to be more alert and more assertive
Jo: Ehe (Maltese: indicates agreement) (.) Continuing on what M is saying it's true at one point for example even they would lower their voice sometimes even whisper like to try and calm him down for example when he was feeling a bit overwhelmed at one point so they adjusted their
Meg: Ehe (Maltese: indicates agreement) (.) something else which was interesting (.) they were alerting the children by calling their names (.) for example 'A go in the tunnel' or 'A do this'
Moderator: OK

Meg: So that I think was alerting (.) emmmmm (.) was alerting them a lot
Andy: I I said before that verbal and nonverbal were used together but I'm reading through (looking at his notes from observation diary) and I'm thinking of instances where they were literally used together (..) give a command verbally and physically you're pointing showing that something is going to happen, so not just intertwining one moment saying the command verbally and you're using nonverbal communication they were used a lot of times simultaneously
Moderator: OK
Andy: And it's very interesting cos you see, and you're like continuously assessing what's working with the child so just giving a verbal 'go into the tunnel' didn't work then add a physical prompt to it and actually move the child towards the tunnel and then the second time around just with the verbal command only and see if the child can get on with that, so you're continuously varying the levels using the two together
Meg: I don't know if you noticed but at some points they were using rhythm as well, At some points they were using melodic voice, repeating the same patterns like 1, 2, 1, 2 (said with melody) or 'ready steady go' and it was helping the children to go into this pattern, it kind of helps, motivates and leads, continues on what the therapists were doing more
Moderator: OK. How did the therapists' interaction differ with the different children? How was it different?
Meg: With child 1, N it was, the child was very passive, so it's like we were saying before, the tone of voice was assertive, everything was more structured but with for example child 4 there was a discrepancy between child 1 and child 4. Child 4 was L I think, he was all over the place, so it was very difficult for him to sit down and settle, so they were giving him more time emmmmm to find out what he wanted and explore the room and then they were directing him but it was more…. it took more time
Jo: Even in terms of the language, it was more simple, in the sense they adapted according to, depending the child obviously, there were some children

who could, you know take a bit more language and others you know needed a bit more for example more simple, concise instructions so
Meg: Even body
Andy: Proximity, placing of the body you mean! What I was (.) what struck me was that no matter what we observed it was very clear the emmmmm the main aim of the therapist so this is what (.) the point we want to get to so for a child that had strong reinforcers they knew exactly what he wanted, puzzles, that's what he wants to do, he's focused, he can get engaged and get there then let's give him what he wants to work on the aim of the project. Other children were, maybe they didn't know them very much yet or they were still very inconsistent or not too many strong reinforcers they played around much more to get, the work was to get him on board to get him to the goal. I think that really changed from one child to the other so we know maybe this child we know know exactly how were gonna get him to the goal so let's get to it straight down (.) boom boom boom (.) get to the goal but for another child that needs more exploration more trial and error change things continuously on the spot, ufff (Maltese: indicates exasperation) (.) this is not working we need to change activity, we need to change place, then they had to think on the spot and keep going around until you get close to the goal
Meg: But I think even the way prompts were given some children needed a lot of prompting, others needed less
Jo: Ehe (Maltese: indicates agreement)
Meg: They were waiting for some children to initiate more, I mean at some points with some children they were using a lot of facial expressions and telling him 'look, you have to show me here' and partial prompting was evident but with other children who were kind of more on the go and alert they seemed to be, they were waiting more, poker face, expressionless faces, waiting for the child to initiate (.) emmmmm
Jo: I felt that the prompting was very evident, in one moment they are literally, always from the back, physically, emmmmm taking the child and even the hand and giving it to the communication partner, but in another moment

Meg: They were calmer, they were ((inaudible)) more, they were looking for the child, with some others there was almost full physical prompting, lots in the beginning
Jo: Yes, in the beginning there was more prompting, yes but towards the end
Andy: In some children even in the same session you can see the shift from full physical prompting to backward chaining, you know fading back yourself
Jo: As we said, they were always altering the level of prompts
Andy: You can see the level of, there were some kids where you could see the progress, the progression (.) their understanding of what they should do in the same session so still doing puzzles but at the same time you're fading out your prompts and you can you can feel it that
Moderator: Anything else?
Andy: Even the structure of the session varied from one child to another, the children needed sensory motor input before, others didn't. Some children needed sensory motor input, some children needed environmental modification for them to, what they needed, so therapists were very attentive, I mean the sessions were planned individually according to the child and some sessions had to change, we know ASD, you can have the child on a bad day and no matter what you plan you have to adapt and modify on the spot so the session, even the planning of the session did change and even some of the choices that were given had to be changed from one session to the other cos something didn't work or you might not have something available and you have to change. A child was continuously getting bugged with the outline of the cell so let's try and change something else. Why is he not pressing on the picture? Is it because the picture is not the same as the object? Is it because he's going to the outer border of the cell, they were continuously improvising and changing the session plan from one time to another, it varied a lot
Moderator: OK, so it's clear that there was adjustment to the different children. Is there anything you noticed in common? Was there anything you would say that this was always observed irrespective of differences (.) emmmmm

Jo: Yes (.) mostly the open hand gesture was always there, whenever it needed to be obviously
Meg: And child facing the communicative partner so they were always getting face to face, I felt to encourage eye contact, were always putting things in front of their eyes to encourage children to look so that's why
Andy: The protocol on the whole
Meg: The session itself
Andy: The session itself was very rigid all through out, you can see it, you can see it
Meg: First sensory motor room then clinic
Andy: Even the way, and I also liked the way that they were testing the child on the spot, so not always one therapist is the communicator, one therapist to facilitate, they were changing to see if the skill is being acquired
Moderator: Yes
Andy: That was, that was for throughout I think, for all the kids, the protocol has to be
Meg: What was really common I think, always providing choices and following their lead stood out the most for me
Andy: And the positive reinforcing, even when a child was biting and pinching continuously they ignored that but still praised and gave good reinforcement to the good stuff that he does
Meg: And the directing, the way they were directing things together was very smooth but sometimes
Andy: Smooth for the kid but evident for us
Meg: Evident for us, they're still getting their way sort of, the transitioning was very smooth for the child to follow they seemed that they were getting, doing what they wanted but
Jo: One thing I noticed, I don't know if you're going to ask about it later (.) ummmm (.) but I think they did it almost with every child, is emmmmm (.) I'm not sure if it's correct correspondence checks like
Meg: Correspondence checks

Jo: For example presenting if the child is going to ask for something for instance the yoghurt they would present him with the yoghurt and the ball and obviously he would have to choose the yoghurt not the ball (.) emmmmm so that, but it wasn't consistent, it was like they did it
Andy: ((in overlap)) At the right time, at the right time
Jo: It was like, you know, just checking, but I saw that yes throughout every session not towards the beginning though, I think it was more towards the end
Andy: When the child, when the children started to acquire the skill then you do the correspondence check to make sure, OK, is it just luck at this point? Or is it that he is really choosing what he wants?
Moderator: In fact it is very much related to the next question, in what way did the therapists adapt when providing their interventions during the sessions?
Jo: What ways?
Moderator: Did they adapt?
Andy: I think the correspondence check played a big role
Jo: ((in overlap)) It was quite
Meg: Yes (.) and I think something else which was very interesting the therapists were discussing continuously and (.) ummm checking what was going, what was right, what they need to improve, both after the sessions and within the sessions so that if something was going wrong they were discussing between them 'listen, let's try this one, or you do this and I'll do this ' they were setting some emmmmm (.) boundaries
Andy: But sticking strictly to the protocol still I really liked the fact that the family was involved so the family members were attending the session, they were actually allowed in the session and they were trying to get explanations for some behaviours there and then, 'did something different happen at home?' 'Was he at school before?' 'Did he eat before he came here?' So they did take what the child's baggage that he brought with him into consideration for the session and they adapted accordingly but I what I realised that for a child a session after the clinic he chose deliberately a picture of the motor sensory room and the next time they did take him for a couple of minutes there, so,

they're there with the child, and he wishes to go there, he might not need it specifically for the session but it's a reinforcer for him, so give it to him, so they did adapt in that way when they were giving intervention. He did a good session, it's only fair if he gets his reward
Moderator: OK
Meg: And also they were getting feedback from the parents through the sessions and seeing how they can provide more things the child likes to, for example, on one occasion the child liked milk and they asked the mother to bring the milk in a different container so they can pour and provide him with
Moderator: OK
Meg: More or less as needed
Jo: Yes, most of the time the mother provided an important part in providing the reinforcers,
Meg: Aha (Maltese: indicates agreement)
Andy: One big adaptation that I saw, one big adaptation that I saw is that physically adapting the environment and the surroundings (.) emmmmm (.) I was surprised in one of the first sessions when the child didn't, was not there to do a table top activity, or something on a chair, or standing, he just went to sit down on the floor, on the mat with this particular toy, and one big adaptation that I saw and I loved it to bits is that they got the, all the procedure, the tablet, and the toys and reinforcers, just sit down on the floor with them, and adapted the whole protocol sitting down on the floor
Meg: Uhummm (Maltese: indicates agreement)
Andy: So they were adapting so quick, it was very evident to us, yet again looked very smooth to the student's eye, so they were doing so much work behind the scene to get everything adapted to the child, so child oriented
Moderator: child centred but adult focused
Jo: Yes, exactly
Meg: And also, the room was being adapted as well, I mean, they were changing the toys depending on the child's preferences as we were saying but also emmmmm with some children specially I think L, they were hide (.) they

were leaving the reinforcers there but they were hiding the extra stuff so that things wouldn't be too overwhelming for him
Jo: Aha (Maltese: indicates agreement)
Meg: I mean they were leaving the things
Jo: Even the reinforcers where they were placed, they weren't placed within reach
Meg: ((in overlap)) Out of reach they were placed
Jo: They could still see them but they couldn't
Moderator: OK
Meg: They would have to ask it
Jo: For them to get them
Andy: There was also adaptation in the communication with the child, for example there was an occasion where one of the therapists was assertive and the child was a bit surprised, and then you quickly adapt your tone, getting him back, you know smooth down your voice, smoothen down the activity and to get him back because he got a bit (.) we know how touchy they can be (.) so like he got all anxious at one bit , wanting to cry because he got a little fright (.) quickly quickly they calmed it down, adapt the voice, adapt their position, adapt the activity to get him calmed down, get him back on board the activity
Meg: Something we didn't mention, the device was always close to the children so even
Jo: Yes
Meg: When they changed table top, on the floor, on the shelf, the device was always quickly adapted and taken towards the child. It was always close
Jo: ((in overlap)) It was always available
Meg: Within reach
Andy: Even the child was taken in consideration, even for example sometimes one of the children didn't actually want to participate in the session and the therapist adapted the whole structured environment, into a more enticing fun environment, he usually likes the ball so let's entice him with the ball, play with the ball, play with the ball, so giving him, adapting the whole structure of the

thing to get him enticed, to come with you, rather than boom boom get him into the activities

Meg: And I felt the therapists were taking time to get to know the children, and looking and seeing, observing what they were doing, and by observing them and seeing what they were doing it would give them insight into how they can adapt the sessions for next time

Moderator: Alright

Meg: Emmmmm through just observing the children and doing their thing

Andy: They are also challenging some of the children, so you're at one point and then you challenge them with a different activity to see how he reacts, get him for next time, errrr, that was quite evident with puzzles kind of thing and relaxation techniques, the two extreme, so you might try something, whether challenging him for more or introducing a relaxation technique to calm him down and get him back to you, so there were two particular things which are quite interesting to see and they got into them, they adapted so quickly, so flexibly that you wouldn't even, I mean cos we were there to observe particular things that's why we see them because otherwise from the child's side (.) OK (.) I don't want to do nothing and then

Moderator: There was a flow

Andy: And then you entice with the ball, he's all over the place with the ball, then the relaxation techniques to get him back to where you want, so it was so smooth, the transition between this, the adaptation was very smooth

Meg: And also emmm one of the children was very anxious and they were preparing a lot of things from before and making him feel, that they know, somehow they were making it look like, the child knew what the therapist was expecting, I mean, they were constant on the way they were presenting him with the things they were very fast, they didn't leave him on his own, he didn't have time to get anxious, they were constantly providing him with things and keeping him like active, saying (.) listen (.) this is what we're going to do next (.) emmmmm which I think had an effect on the outcome of the

Andy: Even who took the lead varied, therapist adapted (.) who's taking the lead according to the child (.) ummmmmm (.) some children were responding better when led by one person
Moderator: OK
Andy: And I noticed that another child was (.) was on board more when someone else led and the therapists were shifting who led the session for that particular activity, very smooth, stepping out and then someone else stepping in and leading the session and you can see that the children respond differently when different therapists lead the session, it could be the way they look, sympathy from the child's side, it could be the way (.) character wise, the tone of voice and your approach, could be the way you position but the children were responding yes, differently to when one particular therapist was leading than the other
Meg: ((inaudible)) Was very common, they were trying, they were using the same toys but the way they were presented was different to try and keep the children engaged
Moderator: OK ((pause)) so to round off (.) of all the things we talked about what do you think was the most important thing and why?
Andy: Emmmm, one big thing that I noticed is the use of self when carrying out the session with the child, you could see, you could feel, even more, you can feel this even more when you're observing than when you're doing the session, ummmmmm the way you as a person change your connection with the child, the way you present activities, the way you use your voice, the way you change without even thinking about it, your position, your voice, your energy in the session, when you see it that way it's unbelievable, we change as a therapists using yourself both physically
Moderator: It's not what you do, is how you do it
Andy: Exactly, it's like physically the way you position to guide the child, the way you add your voice to that physical position, the way you use your eyes and proximity with the child makes a whole big change in the way you present a session

Jo: And I think even if you are going into a session keeping in your mind that you are going to let the child lead I think it was important as well for the therapist, it was very evident to be flexible, to adjust accordingly, ummmmI think that was very important you know, because if you are…if, like you said, it's going to be child centred but (.) emmmmm (.) adult led emmmmm (.) you, you have to be flexible I mean

Meg: Preparation, they were always prepared beforehand the room ready so the child is going in and the child is there everything is prepared

Jo: Ehe (Maltese: indicates agreement)

Meg: Even the actual prompting

Jo: The actual prompting was very evident, yes and important

Andy: And consistent towards the protocol

Meg: Exactly

Andy: It was all throughout. This is the goal, we have to be consistent towards, Ok, child led, very flexible, errr, we adapt change but the consistency and repetition towards the protocol was there underlying and you use yourself accordingly, you change it up, but leading towards your main aim

Moderator: I have a couple of questions, you have touched on it a little bit that you noticed that the therapists maybe communicated differently with different kids, you mentioned child 1 and child 4, so N and L, maybe it will help you if you think about them in terms of the actual kids themselves, so N was child 1, L was child 4, M was child 3 and J was child 2, right, would you have anything more you want to say about that? About how the therapists communicated, be it verbally or nonverbally?

Andy: Child specific?

Moderator: Hmmmm (yes)

Meg: With regards to child 2 and child 3 so?

Moderator: Whatever you want to say that you noticed, you did mention child 3 (M I think) was under aroused or passive as you put it, I mean, and you said that the therapists were more assertive with him, and then you said in relation to L

Meg: ((in overlap)) L was more
Moderator: ((in overlap)) That he was very anxious child and that they were using calming, do you have anything more to say about any of that for any of the children
Meg: I think with regards to J
Jo: The sensory needs, I think the therapists were addressing them quite well for instance on one occasion the therapists wanted to play with the ball but emmm one of the therapists used actually used the ball to apply pressure, and I can't exactly remember what happened but it was, it was something like that so so (.) emmmmm (.) so yes with J that was one thing I noticed (.) emmmmm which
Andy: The only thing with J is that identified that before, If they didn't tackle his sensory issues they it was a big wall getting to the goal
Jo: The sensory issues were present throughout I think it was, for me J was the most evident and emmmmm his sensory issues
Andy: Using calming strategies with him
Jo: Ehe (Maltese: indicates agreement) it helped
Andy: Modifying the environment on the spot to get him what he needs
Meg: We observed J in one instance with one of you, I don't remember which one it was, he was very tired and they were using a lot of alerting strategies,
Jo: ((in overlap)) Yes, yes
Meg: They were I think tickling him
Andy: So this is the same child, so one session we're trying to calm him down with these breathing exercises and deep pressure and another session they had to adapt and change completely to alerting him up, bringing him up to go in the session (.) What was his name, the other one?
Meg: M
Andy: M was pretty straightforward, there was a bit of trial and error in the beginning until they identified what he needed but then it was very smooth, very direct
Jo: I think M was

Andy: Lots of structure
Jo: I think M was one of the sharpest when it comes to learning the device
Andy: Yes
Jo: I think it was M (.) emmmm (.)
Andy: N needed a lot of alerting, N yes had to be alerted in anything that he does, need to be excited and play as you go along
Meg: I think with child 2 as well (J) there was this calm voice and calm approach, he was one of the children that had a lot of bad behaviours, he was hitting, or attempting to bite or run off, so the children the therapists were keeping an expressionless face when they thought he was going to bite or if he pulled their hair to try not to reinforce it more and they, I felt maybe they were trying to modify this behaviour, if he hit, then they applied pressure, they showed him OK, you can do this instead but with re- in terms of voice, was, they weren't using alerting methods, they were keeping it calm
Jo: And with M I noticed that emmmmm that for example they would notice that he would need some breaks and usually they would give him a break between one puzzle and the other and just, to walk a bit around the room and then he would sit right down and continue the puzzle so emmm I think for them that they realised that listen, we need to give M a break between one puzzle and the other so..
Andy: The correspondence checks I think in child 4 started way before because I think he was one of the children that grabbed the concept of the project very quickly, so correspondence checks I mean that started pretty earlier to make sure that he, is he just guessing because he's very rigid or is it because he is really understanding and asking for what he wants... but when it comes to child 4 there was very clear communications strictly to the protocol, he did it himself which was very good in a way, and was very strict in what he wanted and gradually reducing the prompts to zero in the same session so starting from a couple of physical prompts down to zero in the same session, I think he was the one tolerating this the easiest, kind of thing ((pause)) (looking at notes) J then was different, J fluctuated a lot in my opinion, from what I saw he did fluctuate

a lot (.) so from one moment he's there and you can sabotage an activity and introduce my turn, your turn, the next time he's (.) and you have to alert him to get him there and to get his attention
Moderator: So I was asking for clarification on the actual interaction itself, the communication
Jo: (Looking through notes) ah alright, I think as M said, I mean we were, emmmm the level of alertness in the therapists' voice altered depending to to to the child, for example when she, like she said emm when J was feeling a bit low and and they had to use a a voice that was a bit more alert, so I think that was quite evident
Andy: N, his communication was much more alerting, higher pitched voice, much more exciting, much more variety from one thing to the other, lots of spontaneity moving towards from one activity to the other, so that did vary as well ((pause)) (Looking through notes) even the structure level was different, how much the session was structured from one child to the other differed, we mentioned this before, for the puzzle guy, very structured
((General laughter))
Meg: Puzzle guy
Andy: I'm very bad with names so I remember children with a particular characteristic so yes ummm he could handle structure and they gave structure to get him to the goal of the session. Other children like J where so many things were interfering the communication changed and less structure was used (.) and that's something that you could realise. The other two were pretty similar I think, they both fluctuated from one [session to the other]
Meg: ((in overlap)) I think J and L were pretty similar
Jo: J was a bit
Meg: J (.) .errr except when he was going to sleep
Jo: Yes
Meg: But I think in terms of behaviour
Jo: J was a bit like that and a bit more like that and L was all over the place, no? In what sense more similar?

Meg: the way he goes about things
Andy: their approach
Jo: ((in overlap)) their approach, yes, OK
Meg: ((in overlap)) Even the way they were working, I felt that with J and L they were very fast and constantly doing stuff but with N and M the feeling was more like soft and flowy
Andy: ((in overlap)) There was more structure, more pace
Meg: But with J and L it was more boom, boom, boom (snapping fingers) kind of fast paced
Jo: ((in overlap)) Yes, it had to be at a faster pace
Andy: Up and down the most I saw I think was J, was impressed, his level
Meg: But J's level
Andy: Unbelievable (.) the others they were more a bit more (.) there was a kind of pattern, so even communication, even if it at this point we reduce the physical prompting then it was consistent where we're shifting away from physical prompting to verbal prompting, there was like consistency OK we're at this level, now what's next? But when it comes to J I think I saw ups and downs going back to square one multiple times resorting back to physical prompting at some point with his mood
Assistant Moderator: OK, I'm just going to sum up what I'm hearing from you, I'm hearing that on the one hand because I had already written down adaptability and flexibility before we had gotten to that question, because that was coming up as a very strong theme
Meg: Uhmmmmm (agreement)
Assistant Moderator: Yet on the other hand I'm hearing that we were also quite rigid (laughs), and mainly in respect of the protocol and getting to where we wanted to get to which was our final goal, but then we were very, from what I'm hearing from you was that we were quite adaptable we used flexibility In many different aspects including providing fun and novelty and making it a fun interaction, emmm the interactions themselves and how we interacted both in terms of our communication, which was verbal or nonverbal, emmmm the

equipment that we used, emmmm the sen- the use of sensory motor room and or strategies (.) emmmmm (.) we were flexible in terms of providing opportunities for communication, and underlying this I think was the idea I think that if we didn't have motivators you mentioned this MANY times, that that was almost like the motivators, being able to connect were like I'm hearing them as (.) base foundations let's put it that way (.) foundations

Jo: Yes

Andy: ((in overlap)) Yes

Assistant Moderator: That are needed to build on (.) emmmmm (.) also I liked that you spoke about how we used flexibility to challenge but altern- at other times

Andy: To go down

Assistant Moderator: To go down so I thought that was interesting and yeah I suppose we did have quite a rigid approach sometimes

Andy: What I see is two binaries (.) like (laughs) the way you have the goal that you want to reach so obviously you need to keep up with that and be rigid but then you have the therapeutic arts, that's the art of therapy, you need to change and adapt in order to get to your goal so if you want a summary

Assistant Moderator: Yeah, no no that's exactly, that was the theme what I picked up, yes

Andy: The flexibility, the changing and that, but obviously always doing that in order to keep, to get to the goal

Assistant Moderator: Thank you everyone for taking part in the study. I'll stop recording now

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1hr 53secs

Appendix 17

Study 4: Thematic analyses- focus group

Initial coding

Data extract	Initial codes
Moderator: Let's start with the first question, so can you tell me a little about your professional backgrounds?	
Andy: I'm an occupational therapist, been working as an occupational therapist at ACTU for the last year, I worked mainly, apart from my university studies with children, so I'm directing towards that expertise. I'm also doing a masters in humanitarian action so basically dealing with humanitarian crisis focusing on children coming from a migrant background and inclusion in education	
Jo: I'm a speech therapist. I've been working at ACTU since er July. Emmmmm, I've had (.) during my placements I've had some experience a little bit with adults but mostly with children so I must say I feel a bit more confident (.) mmm (.) working with children (.) uuuum (.) ((laughs))	
Moderator: Anything else related? Anything else maybe that	
Jo: Not really ((laughs))	
Moderator: Alright	

Meg: I'm a speech therapist as well. I graduated in 2012. I've been working in ACTU since March 2017, close to a year now, March 20th will be a year. Mostly placement I had quite a varied placement, I had geriatric placement but mostly children, preference? I prefer the paediatric side of it. Emmmmm with regards to placement with AAC I did not have that much exposure, emmmmm, but I think ACTU it helped me grow my knowledge a lot of aac and also the cases we have (.) I work with Andy and my knowledge grows as well on that aspect depending on the cases we have	
Moderator: OK…alright, OK so let's continue with the second question, so think back to the last time you were working with a child with ASD, OK, how did you establish a connection with the child?	
Andy: I've experienced different scenarios when it comes to children with ASD, I've experienced children where you can quickly establish yourself with the child, in his little circle, where you go in very quickly, some children do let you in very quickly, I mean that's what I feel, then I can think of a particular child where it took us almost 8-9 months of regular intervention with the child to actually finally get some eye contact and actually get into his circle and you can feel that you're there, that's he's there with you	• Children with ASC are not all the same • You can establish a connection more easily with some children with ASC than others • You have to persist to establish connections with some children • When you establish a connection you can feel it

and you can start doing something, a very good 8-9 months I think	• You need to establish a connection to successfully implement intervention
Jo: And I think, mainly as well to add on to what Andy said, I think what I found from my experience at ACTU is, emmmmm, apart from trying obviously to get into the child's circle is maybe, more like taking the child's lead, and I think that's that's something which I found very helpful, if you keep that in mind, I think when you are with children, taking the child's lead (.) and then moving on from there, so I found that quite helpful	• Taking the child's lead helps to establish a connection • You need to establish a connection to successfully implement intervention
Meg: Similar to what the others said, I mean I feel autism is a very very vast spectrum emmmmm sometimes you have a child who comes in the clinic and you feel they connected easily with you, even the reinforcers you use, you feel you click on that level with them but sometimes it requires more work from your end to kind of set the boundaries of the relationship between you and make the child feel comfortable so he can trust you and I think the element of trust and comfort plays a big role in the relationship between you and the child, I mean sometimes children with autism lack eye contact and facial expressions but sometimes they show you in other ways relating (.) they take your hand direct you to what they want. In a way	• Children with ASC are not all the same • You have to keep trying to establish a connection • Trust is important to form a connection • The child's comfort is important to form a connection • A connection with a child with ASC may not be obvious

you can still emmmm read what they want to tell you and you can feel a connection	
Andy: Although it might sound superficial sometimes even trial and error, you try something with a child and you say OK, I'm nowhere close to	• You have to keep trying to establish a connection
Meg: Sometimes what works with one child won't work with another	• Children with ASC are not all the same
Andy: YES! Sometimes you might say OK, his parents might tell you he's very technologically inclined, so you say OK, using technology to get into his circle but then you use technology and it becomes his only thing and he blocks you out because of the computer. Then you say OK so next time let's keep the computer switched off and try something else, trial and error one session after the other, and then it's like, OK, here we've got something, he likes bubbles, OK so let's, we have something, let's work on this	• Some reinforcers can get in the way of forming a connection • Strong reinforcers may need to be avoided in interventions • Reinforcers can be helpful to form a connection with a child with ASC • You need to try out different reinforcers to find out what works best for interventions • It can take time to identify a child's reinforcers
Moderator: Using what the child likes	
Meg: And sometimes I feel, you have a child, you try everything and nothing works, and you say what am I doing wrong? Is it the room? The new place? The toys? Is it me? Emmmmm but then he comes to the next session, first he's crying and then he calms down, then he's smiling at you, he takes off his jacket, he	• It can be difficult to connect with a child with ASC • You have to keep trying to establish a connection

shows you that he's comfortable, he approaches you, he starts looking and exploring	• The child's comfort is important to form a connection • Recognising when a child with ASC approaches you he is beginning to establish a connection with you
Andy: And you say, is this the same child? What happened during these two weeks?	• Sometimes a connection may be suddenly established
Moderator: Is there anything that you feel, maybe that you use, any particular techniques or maybe even objects that maybe you feel enhance the connection with the child?	
Andy: We involve the family a lot, and we ask in the school and the home environment what really motivates the child to connect with the child	• Family involvement can help to establish a connection • Reinforcers can be helpful to form a connection with a child with ASC • Involving the school can be helpful
Moderator: More specifically about connecting with the child, is there anything in particular maybe that you did, in particular, I don't know (.) ehm, as I said it could be something you use or maybe your own natural way that you dealt with the child?	
Meg: I think it's very important, the way you approach the child, not making him feel	• The way you approach a child can impact on establishing a connection

intrusive and also the tone of voice plays a very important role I feel	• The clinician's communication skills play a role in establishing a connection
Moderator: OK	
Meg: The way you give instructions to the child, you can give him the liberty to make choices but at the same time you need to say listen, we're going to do this and this	• Offering choices can support connections to be formed • Connecting with the child does not mean that s/he is free to do what he wants
Jo: I think using techniques like observe, wait and listen	• Techniques have impact
Meg: Following the child's lead	• Following the child's lead is used
Jo: Yes (.) as Meg said, providing choices I think it's very very important	• Offering choices can support connections to be formed
Andy: I like to look at it from a fun point of view	• Having fun supports the formation of connections
Meg: Ehe (Maltese: indicates agreement)	
Moderator: OK	
Andy: Cos sometimes when children feel you put too many demands on them they see you as as a (.) like a test or at school. Most of the time we try to approach through a fun kind of approach, if it's a motor sensory activity, if it's emmm working or any components that we are trying to work on we try to find a fun tweak to it, to get to him, I mean in my	• Being demanding can stop the formation of connections between child and clinician • It is possible to have fun in any activity

experience, it seems to work more than sitting down and this this this, and schedules and very rigid intrusive kind of approach	• Being too rigid can impede the formation of connections • Fun activities can be more effective than activities where a child has to sit down
Jo: I think even the toys we provide them with, I mean we try to find toys which they like, that are very stimulating	• Stimulating toys can be helpful with a child with ASC
Meg: But sometimes you, we need to bargain sort of and provide rewards, let's do one last one and then you can do what you want, the drums or the blocks or whatever emmmmm	• Providing rewards is important • Negotiating with the child is important in interventions
Moderator: So like multiple	
Meg: YES	
Moderator: Is there anything else you would add to this?	
Andy: Environment as well, you might realise that a particular environment is just not working for the child, and so you might say let's try something else, let's try school, let's try home to get into, maybe you know in that particular moment you as a new person or the therapist and people in the room, the whole environment thing it's too much for him, you might say OK, we need to do something drastic, let's change the environment	• Different environments can impact forming connections differently
Moderator: Alright, so you were asked to observe the interactions between therapists	

and children, can you tell me about your observations?	
Andy: One main thing that I observed is that how quickly a therapist can shift from one technique to the other	• Clinicians rapidly change between one strategy and another
Meg: Flexibility, you're saying?	
Andy: Very much	
Jo: Ehe (Maltese: indicates agreement), in terms of being flexible I saw that very much, I mean in one instance they are using one technique and then you know you see the child is responding in a certain way and OK, then they have to change it, and you know, according to how the child is responding, so yes I agree with Andy	• Being flexible in use of strategies is used • Strategies are selected according to how the child responds
Andy: Even the prompt hierarchy	• A prompt hierarchy was used during intervention
Jo: Ehe (Maltese: indicates agreement) the prompts, exactly	• A prompt hierarchy was used during intervention
Andy: Going up and down all throughout the session	• Prompts are faded and reintroduced in interventions
Jo: They're always either providing a bit more prompting and then like backward chaining, they're pulling away slowly slowly	• Prompts are faded and reintroduced in interventions
Andy: At same time	
Meg: It's like what they're saying, everything was structured, they did the same activities with different the children but their approach varied according to the child, with one child	• Sessions are structured • The approach varies for each child

there was less prompting, with another there was more, depending on how the child presented during the session, flexibility, the spontaneity as well, sometimes they had children who came in the clinic, and I don't know, were frustrated on the day they had to come up with something	• Different levels of prompts are required • The clinician is responsive
Jo: Uummmm (agreement)	
Meg: That was, it was very nice to observe as well	
Moderator: OK, alright, good, emmmmm, how do you think the therapists' nonverbal communication affected the interactions?	
Andy: Very much	
Meg: Very much	
Andy: Cos it was, it was actually their key thing of getting the child to where you want. I think the whole scope of the session the goal was pretty much defined, pretty straightforward so all the kids came there for one specific goal, we all knew it and you could feel it in the session that, that is the ultimate goal of all of this but then, to get to it, I mean using from physically guiding the child to lessening your prompt to visually pointing towards something else, it was impressive, I mean, the child was guided throughout from starting to the goal	• The clinician's nonverbal communication plays a role in intervention • AAC goals were established • Supported achievement of therapy goals • A prompt hierarchy was used during intervention
Moderator: What aspects of nonverbal communication?	

Meg: I think, I noticed the face	• Facial expressions played a part in the interventions
Jo: A lot, and the tone of voice	• The tone of voice played a part in the interventions
Meg: Eyes	• The eyes were used in the interventions
Jo: I noticed it almost in every session, the tone of voice when they are using a reward (.) whooooo [with exaggerated intonation], it was like (.) you know (.) kind of trying to get him (.) and even on one occasion when they were for example it was a bubble popping activity, emm, there was lots of wow [with exaggerated intonation]. You know, I think that helped the child to even you know, get him into the activity even more, so that I observed it, almost I think every session	• The tone of voice played a part in the interventions
Meg: I remember lots of use of facial expressions, exaggerated facial expressions (.) emmm looking as well I remember emmm one instance they had a child who was wanting something different and the therapist looked in the same direction to kind of connect with the child and experience the same thing the child was looking at in that instance. And also, I remember (.) there were instances where the therapists were setting boundaries emmm (.) physically (.) I mean not using verbal instruction but they were blocking the table or or part of the room for the child not to escape but by their physical	• Facial expressions played a part in interventions • Looking at what the child is interested in supports a connection • Boundary setting using furniture can be helpful

Andy: Even where you place yourself (.) how close to the child which level, at which height, sitting down if the child is just refusing to do an activity at the table and he sits down on the floor, physically positioning yourself on the floor in front of him	• The use of the clinician's body varied according to the child
Jo: Yes (.) for example most of the time like Andy said they leaned towards the child, they were crouching, what I noticed as well was the open hand gesture for example they would do this [shows with own hands] (.) they're expecting, and even the body language	• The clinician uses his/her body during interventions • The clinician shows that s/he is expecting the child to respond
Meg: Similar to what you're saying at some points they would stare at the child and wait	• Techniques have impact • The clinician shows that s/he is expecting the child to respond
Jo: Exactly	
Meg: They're looking at the child expectantly	• The clinician shows that s/he is expecting the child to respond
Jo: Waiting	• Techniques have impact
Meg: With an expectant look	• The clinician shows that s/he is expecting the child to respond
Jo: Ehe (Maltese: indicates agreement)	
Meg: For a gesture, a verbalisation, sometimes I feel during clinics we want to say a lot and we don't give time for the child to do much	• The clinician shows that s/he is expecting the child to respond • We should give time for the child to respond

	• The child can respond in many ways
Jo: We overload them	• Talking too much can overload a child
Meg: And they were waiting and taking the child's lead and they were really observing and waiting for the child to initiate, giving them time	• Techniques have impact • We should give time for the child to respond
Moderator: OK	
Meg: Not with all of them, but with some	• You need to wait longer with some children than others
Moderator: anything else?	
Jo: Emmm I noticed as well the way they changed their voice, for example, on one particular occasion, we had a, one of the children was feeling quite low and the tone of voice was more, like, you, know, alerting so (.) and even calling his name (.) for example (.) before (.) you know trying to get him to do something, emmmm (.) yes I noticed the use of touch	• Tone of voice can be used differently in interventions • An alerting tone of voice can be used with children who are hypo-reactive • Calling a child's name can be used to alert a hypo-reactive child • Touch can be used to alert a hypo-reactive child
Meg: And physical (.) hekk (Maltese: translates 'that way') touch was being used to alert or to calm down or to redirect sometimes when they were saying a verbal instruction and it wasn't being understood by the child they used to take his hand for example and direct him to where they wanted the child to go, to what they wanted him to do	• Touch can be used to calm • Touch can be used to alert • Touch and physical guidance can be used to support comprehension

Andy: Some nonverbal communication was used in other ways (.) when you want to ignore something, when you want to correct a behaviour by ignoring a behaviour for example	• Nonverbal communication can be used to manage undesired behaviours • Nonverbal communication can be used to achieve other goals
Moderator: OK	
Andy: Child was pinching, you ignore that, he might try to bite you and you try to ignore that ((laughs)). Nonverbal communication, it's not, the way I've seen, it's not always to emmmm push towards to something else, to correct from the other side	• Nonverbal communication can be used to manage undesired behaviours
Moderator: OK	
Andy: It's quite interesting to see that	
Meg: There were lots of pointing as well	• Pointing is used to support interventions
Jo: Pointing, even while giving verbal commands, for example, if they tell them (.) on one occasion they told them for example sit down on the chair, point, even when, I remember on one occasion (.) errrr (.).the child was trying to vocalize 'mama' and they told him 'yes, look, mummy'	• Pointing is used to support interventions • Pointing is used in conjunction with words • Pointing can be used to support comprehension during interventions • Interpreting vocalisations is used during interventions
Moderator: OK	
Meg: There was a total communication approach as well	• A total communication approach is used during interventions

Jo: Exactly	
Meg: So there were gestures, materials, verbal cues, there was a lot going on	• A total communication approach is used during interventions • Verbal cues are used during interventions • Materials are used in interventions • A combination of strategies is required for successful interventions
Moderator: OK, good, anything else?	
Andy: When it comes to nonverbal?	
Moderator: What about the verbal, how do you, what did you observe in terms of how the therapists communicated verbally?	
Andy: Verbal, I think it was used a lot to alert or to calm a child, so the way you put words, short, direct, loud instructions to get the child with you. Soft voice to get that joint attention, get the child involved with you	• Tone of voice can be used to alert • Tone of voice can be used to calm • The clinician's communication skills play a role in interventions • Soft voice can support joint attention • The clinician's communication skills play a role in establishing a connection
Jo: Verbal reinforcement I noticed as well	• Praise is used in intervention

Meg: Positive reinforcement	• Praise is used in intervention
Jo: Positive reinforcement yes, emmmm, also saying, for example if the child is making a request (.) emmmmm (.) he requested ball usually the therapists would say 'ball', they would continue and repeat the word and I noticed that every session actually	• Praise is used in intervention • Repeating the child's communication attempts with the AAC device is reinforcing
Meg: Short instructions and to the point	• The clinician uses short direct instructions during the intervention
Jo: Choose. literally CHOOSE	• The clinician uses short direct instructions during the intervention
Meg: 'Go there' 'do this' (.) emmm (.) and also they were expanding on what the child was saying at some points the child said 'ball', ah, 'you want ball' or 'red ball'	• The clinician uses short direct instructions during the intervention • Expanding on the child's communication attempts with the AAC device is used during interventions
Jo: 'Yes, you've got the ball' for example	• Expanding on the child's communication attempts with the AAC device is used during interventions
Meg: 'You've got the ball', there was a lot of encouragement as well going on 'you can do it, you did it, you're nearly there' emmmm 'go on' there was a lot of this	• Expanding on the child's communication attempts with the AAC device is used during interventions

	• Children are given verbal encouragement during interventions
Moderator: Alright	
Andy: Verbally, they also were working on different things at the same time, introducing things such as 'it's my turn, your turn' , getting the child on board with changing the activity and moving on to something else, so verbally they were guiding the child a lot towards what they wanted him to do	• Sessions targeting AAC skills can also target other skills • Supported achievement of therapy goals • The child clinician connection supports the child to do the activities
Moderator: OK, anything else in terms of verbal communication?	
Andy: They introduced, like, the negative aspect	
Meg: I remember	
Andy: For example he was pressing 'juice' and the child had no juice 'no juice' so they were like, using verbal communication to indicate negation 'no this' that was quite nice to see	• Other communicative functions apart from requesting may be modelled through expanding on the child's communication attempts with the AAC device
Meg: And I remember with some children (.) emmmm (.) they wanted more (.) and they were creating communication opportunities as they go along, I mean e.g., a puzzle activity and they were sabotaging the activity to create communication opportunities, for	• Creating communication opportunities is used as a strategy • Sabotaging activities creates communication opportunities

example, taking the puzzle pieces so the child can ask for more and encouraging the child 'you can tell me, you can ask for more' (.) emmm (.) and sabotage I think they were using as well a lot	
Moderator: Right, OK	
Andy: Verbal cues that were going on (.) they were not consistent, it depends on the child's performance, the time in the activity cos then there might be an activity where he likes it or a session where he feels less frustrated and then he just keeps on going, you can use nonverbal communication, just guide him to where you want so verbal and nonverbal communication were very much intertwined and depends on the child's performance in that particular time	• Verbal cues are used during interventions • The use of verbal cues depends on the child's performance • Children can fluctuate between sessions • Children can fluctuate between activities • Supported achievement of therapy goals • Nonverbal and verbal communication used by clinicians is intertwined • Communication is adapted to the child in real time
Meg: And I think at some points they were also highlighting what the child was doing, for example, 'good asking'	• Clinicians describe what the child is doing with the AAC device
Jo: That's good, always labelling, they didn't just repeat if the child requested ball, 'ah, ok, ball' 'you want ball or yoghurt' not just labelling it, emmmmmm (.) literally anything that the child is going to ask for that I noticed	• Expanding on the child's communication attempts with the AAC device is used during interventions

Andy: Verbally they were also attentive to the language of the child, some children were Maltese speaking and some children were English speaking	• Adapting to the child's native language is used
Moderator: Ehuummmmm (agreement)	
Andy: So therapists were making an emphasis that if, you get carried away quickly especially if you have one session after the other, if you're speaking in English, but then they were very alert (.) this is a Maltese speaking child so instructions and commands should be in Maltese and that is very important to keep in mind as well	• Adapting to the child's native language is used
Moderator: OK, anything else?	
Meg: I don't know if we mentioned this but the way the instructions were being given sometimes they were loud and assertive, sometimes they were soft and mellow, and calm depending on the child's feeling. If the child was on the go and active the tone tended to be more calm but when the child was really passive then the tone tended to be more alert and more assertive	• The tone of voice is used in interventions • Tone of voice is adapted to the child • An alerting tone of voice can be used with children who are hypo-reactive • A calming tone of voice used with children who are hyper-reactive
Jo: Ehe (Maltese: indicates agreement) (.) Continuing on what M is saying it's true at one point for example even they would lower their voice sometimes even whisper like to try and calm him down for example when he was feeling a bit overwhelmed at one point so they adjusted their	• A calming tone of voice is used with children who are hyper-reactive • Tone of voice is adapted to the child

Meg: Ehe (Maltese: indicates agreement) (.) something else which was interesting (.) they were alerting the children by calling their names (.) for example 'A go in the tunnel' or 'A do this'	• Calling a child's name can be used to alert a hypo-reactive child
Moderator: OK	
Meg: So that I think was alerting (.) emmmmm (.) was alerting them a lot	• Calling a child's name can used to alert a hypo-reactive child
Andy: I I said before that verbal and nonverbal were used together but I'm reading through (looking at his notes from observation diary) and I'm thinking of instances where they were literally used together (..) give a command verbally and physically you're pointing showing that something is going to happen, so not just intertwining one moment saying the command verbally and you're using nonverbal communication they were used a lot of times simultaneously	• Nonverbal and verbal communication used by clinicians is intertwined • Pointing is used to support interventions • Comprehension is supported during interventions
Moderator: OK	
Andy: And it's very interesting cos you see, and you're like continuously assessing what's working with the child so just giving a verbal 'go into the tunnel' didn't work then add a physical prompt to it and actually move the child towards the tunnel and then the second time around just with the verbal command only and see if the child can get on with that, so you're continuously varying the levels using the two together	• Pointing is used to support interventions • Comprehension is supported during interventions • The clinician continuously assesses and adapts accordingly

Meg: I don't know if you noticed but at some points they were using rhythm as well, At some points they were using melodic voice, repeating the same patterns like 1, 2, 1, 2 (said with melody) or 'ready steady go' and it was helping the children to go into this pattern, it kind of helps, motivates and leads, continues on what the therapists were doing more	• Rhythm and melody is used during interventions • Nonverbal communication supports the child clinician connection
Moderator: OK. How did the therapists' interaction differ with the different children? How was it different?	
Meg: With child 1, N it was, the child was very passive, so it's like we were saying before, the tone of voice was assertive, everything was more structured but with for example child 4 there was a discrepancy between child 1 and child 4. Child 4 was L I think, he was all over the place, so it was very difficult for him to sit down and settle, so they were giving him more time emmmmm to find out what he wanted and explore the room and then they were directing him but it was more…. it took more time	• An alerting tone of voice can be used with children who are hypo-reactive • Time is needed to identify reinforcers with some children • Children with ASC are not all the same
Jo: Even in terms of the language, it was more simple, in the sense they adapted according to, depending the child obviously, there were some children who could, you know take a bit more language and others you know needed a bit more for example more simple, concise instructions so	• The clinician adapts language input according to the child • Comprehension skills vary in children with ASC

Meg: Even body	• The use of the clinician's body varied according to the child
Andy: Proximity, placing of the body you mean! What I was (.) what struck me was that no matter what we observed it was very clear the emmmmm the main aim of the therapist so this is what (.) the point we want to get to so for a child that had strong reinforcers they knew exactly what he wanted, puzzles, that's what he wants to do, he's focused, he can get engaged and get there then let's give him what he wants to work on the aim of the project. Other children were, maybe they didn't know them very much yet or they were still very inconsistent or not too many strong reinforcers they played around much more to get, the work was to get him on board to get him to the goal. I think that really changed from one child to the other so we know maybe this child we know know exactly how we're gonna get him to the goal so let's get to it straight down (.) boom boom boom (.) get to the goal but for another child that needs more exploration more trial and error change things continuously on the spot, ufff (Maltese: indicates exasperation) (.) this is not working we need to change activity, we need to change place, then they had to think on the spot and keep going around until you get close to the goal	• The use of the clinician's body varied according to the child • AAC goals are clear • Reinforcers can be helpful to work on intervention goals in AAC interventions • You need to establish a connection to successfully implement intervention • Reinforcers are different for different children • Intervention is adapted according to the child • Persistence is sometimes required to successfully implement interventions successfully with some children • The clinician needs to be adaptable to successfully implement interventions • The clinician is responsive

Meg: But I think even the way prompts were given some children needed a lot of prompting, others needed less	• Some children need more prompting than others
Jo: Ehe (Maltese: indicates agreement)	
Meg: They were waiting for some children to initiate more, I mean at some points with some children they were using a lot of facial expressions and telling him 'look, you have to show me here' and partial prompting was evident but with other children who were kind of more on the go and alert they seemed to be, they were waiting more, poker face, expressionless faces, waiting for the child to initiate (.) emmmmm	• Techniques have impact • Clinicians wait for children to initiate • Facial expressions played a part in the interventions • Facial expressions were less used with children who were hyper-reactive • Facial expressions were used more with some children
Jo: I felt that the prompting was very evident, in one moment they are literally, always from the back, physically, emmmmm taking the child and even the hand and giving it to the communication partner, but in another moment	• A prompt hierarchy is used during intervention
Meg: They were calmer, they were ((inaudible)) more, they were looking for the child, with some others there was almost full physical prompting, lots in the beginning	• Some children need more prompting than others • There is more physical prompting at the beginning of interventions
Jo: Yes, in the beginning there was more prompting, yes but towards the end	• There is more physical prompting at the beginning of interventions
Andy: In some children even in the same session you can see the shift from full physical	• Clinicians fade prompts according to the child

prompting to backward chaining, you know fading back yourself	• A prompt hierarchy was used during intervention
Jo: As we said, they were always altering the level of prompts	• Clinicians alter the level of prompting
Andy: You can see the level of, there were some kids where you could see the progress, the progression (.) their understanding of what they should do in the same session so still doing puzzles but at the same time you're fading out your prompts and you can you can feel it that	• Children learn to use AAC systems at different speeds • Clinicians fade prompts according to the child
Moderator: Anything else?	
Andy: Even the structure of the session varied from one child to another, the children needed sensory motor input before, others didn't. Some children needed sensory motor input, some children needed environmental modification for them to, what they needed, so therapists were very attentive, I mean the sessions were planned individually according to the child and some sessions had to change, we know ASD, you can have the child on a bad day and no matter what you plan you have to adapt and modify on the spot so the session, even the planning of the session did change and even some of the choices that were given had to be changed from one session to the other cos something didn't work or you might not have something available and you have to change. A child was continuously getting bugged with the outline of the cell so	• Some children require more structure in sessions than others • Session structure is planned individually for each child • Some children need sensory motor input prior to AAC interventions • Some children need environmental modifications embedded within the AAC interventions • The clinician needs to be flexible during interventions • The clinician is responsive • You have to find a way to make things work in interventions

let's try and change something else. Why is he not pressing on the picture? Is it because the picture is not the same as the object? Is it because he's going to the outer border of the cell, they were continuously improvising and changing the session plan from one time to another, it varied a lot	• Changes to how the vocabulary is displayed may need to be made
Moderator: OK, so it's clear that there was adjustment to the different children. Is there anything you noticed in common? Was there anything you would say that this was always observed irrespective of differences (.) emmmmm	
Jo: Yes (.) mostly the open hand gesture was always there, whenever it needed to be obviously	• Clinicians fade prompts according to the child • A prompt hierarchy was used during intervention
Meg: And child facing the communicative partner so they were always getting face to face, I felt to encourage eye contact, were always putting things in front of their eyes to encourage children to look so that's why	• Getting face to face is used in interventions • The eyes were used in the interventions
Andy: The protocol on the whole	• A prompt hierarchy is used during interventions
Meg: The session itself	• Sessions are structured
Andy: The session itself was very rigid all through out, you can see it, you can see it	• Sessions are structured
Meg: First sensory motor room then clinic	• Some children need sensory motor input prior to AAC interventions

Andy: Even the way, and I also liked the way that they were testing the child on the spot, so not always one therapist is the communicator, one therapist to facilitate, they were changing to see if the skill is being acquired	• A range of communicative partners are used • Checking for generalisation of skills is used
Moderator: Yes	
Andy: That was, that was for throughout I think, for all the kids, the protocol has to be	
Meg: What was really common I think, always providing choices and following their lead stood out the most for me	• Choices are always provided • Following the child's lead is used
Andy: And the positive reinforcing, even when a child was biting and pinching continuously they ignored that but still praised and gave good reinforcement to the good stuff that he does	• Praise is used in intervention
Meg: And the directing, the way they were directing things together was very smooth but sometimes	• Clinicians work together • Activities should flow from one to the other
Andy: Smooth for the kid but evident for us	• Activities should flow from one to the other
Meg: Evident for us, they're still getting their way sort of, the transitioning was very smooth for the child to follow they seemed that they were getting, doing what they wanted but	• Following the child's lead is used • Activities should flow from one to the other
Jo: One thing I noticed, I don't know if you're going to ask about it later (.) ummmm (.) but I think they did it almost with every child, is emmmmm (.) I'm not sure if it's correct correspondence checks like	• Correspondence checks are used

Meg: Correspondence checks	• Correspondence checks are used
Jo: For example presenting if the child is going to ask for something for instance the yoghurt they would present him with the yoghurt and the ball and obviously he would have to choose the yoghurt not the ball (.) emmmmm so that, but it wasn't consistent, it was like they did it	• Correspondence checks are used
Andy: ((in overlap)) At the right time, at the right time	
Jo: It was like, you know, just checking, but I saw that yes throughout every session not towards the beginning though, I think it was more towards the end	• Correspondence checks are used more as the child attends more intervention sessions
Andy: When the child, when the children started to acquire the skill then you do the correspondence check to make sure, OK, is it just luck at this point? Or is it that he is really choosing what he wants?	• Correspondence checks are used to check the child has acquired the skill
Moderator: In fact it is very much related to the next question, in what way did the therapists adapt when providing their interventions during the sessions?	
Jo: What ways?	
Moderator: Did they adapt?	
Andy: I think the correspondence check played a big role	• Correspondence checks are important
Jo: ((in overlap)) It was quite	

Meg: Yes (.) and I think something else which was very interesting the therapists were discussing continuously and (.) ummm checking what was going, what was right, what they need to improve, both after the sessions and within the sessions so that if something was going wrong they were discussing between them 'listen, let's try this one, or you do this and I'll do this ' they were setting some emmmmm (.) boundaries	• Clinicians communicate together in sessions • Clinicians work together • Clinicians troubleshoot strategies together
Andy: But sticking strictly to the protocol still I really liked the fact that the family was involved so the family members were attending the session, they were actually allowed in the session and they were trying to get explanations for some behaviours there and then, 'did something different happen at home?' 'was he at school before?' 'did he eat before he came here?' So they did take what the child's baggage that he brought with him into consideration for the session and they adapted accordingly but I what I realised that for a child a session after the clinic he chose deliberately a picture of the motor sensory room and the next time they did take him for a couple of minutes there, so, they're there with the child, and he wishes to go there, he might not need it specifically for the session but it's a reinforcer for him, so give it to him, so they did adapt in that way when they were	• It is important to follow through the prompt hierarchy • Family members are involved in intervention sessions • Being flexible in use of strategies is used • Strategies are selected according to how the child responds

giving intervention. He did a good session, it's only fair if he gets his reward	
Moderator: OK	
Meg: And also they were getting feedback from the parents through the sessions and seeing how they can provide more things the child likes to, for example, on one occasion the child liked milk and they asked the mother to bring the milk in a different container so they can pour and provide him with	• Family members are involved in intervention sessions
Moderator: OK	
Meg: More or less as needed	
Jo: Yes, most of the time the mother provided an important part in providing the reinforcers,	• Family members are involved in intervention sessions
Meg: Aha (Maltese: indicates agreement)	
Andy: One big adaptation that I saw, one big adaptation that I saw is that physically adapting the environment and the surroundings (.) emmmmm (.) I was surprised in one of the first sessions when the child didn't, was not there to do a table top activity, or something on a chair, or standing, he just went to sit down on the floor, on the mat with this particular toy, and one big adaptation that I saw and I loved it to bits is that they got the, all the procedure, the tablet, and the toys and reinforcers, just sit down on the floor with them, and adapted the whole protocol sitting down on the floor	• Environmental modifications are used • Following the child's lead is used • Being flexible in use of strategies is used

Meg: Uhummm (Maltese: indicates agreement)	
Andy: So they were adapting so quick, it was very evident to us, yet again looked very smooth to the student's eye, so they were doing so much work behind the scene to get everything adapted to the child, so child oriented	• Being flexible in use of strategies is used • Speed of adaptability is evident • AAC interventions are child oriented
Moderator: child centred but adult focused	
Jo: Yes, exactly	
Meg: And also, the room was being adapted as well, I mean, they were changing the toys depending on the child's preferences as we were saying but also emmmmm with some children specially I think L, they were hide (.) they were leaving the reinforcers there but they were hiding the extra stuff so that things wouldn't be too overwhelming for him	• Room adaptations are planned according to the child • Toys chosen according to the child • Environment is not overwhelming
Jo: Aha (Maltese: indicates agreement)	
Meg: I mean they were leaving the things	
Jo: Even the reinforcers where they were placed, they weren't placed within reach	• Room adaptations are planned according to the child
Meg: ((in overlap)) Out of reach they were placed	
Jo: They could still see them but they couldn't	• Room adaptations are planned according to the child
Moderator: OK	

Meg: They would have to ask it	• Creating communication opportunities is used as a strategy
Jo: For them to get them	
Andy: There was also adaptation in the communication with the child, for example there was an occasion where one of the therapists was assertive and the child was a bit surprised, and then you quickly adapt your tone, getting him back, you know smooth down your voice, smoothen down the activity and to get him back because he got a bit (.) we know how touchy they can be (.) so like he got all anxious at one bit , wanting to cry because he got a little fright (.) quickly quickly they calmed it down, adapt the voice, adapt their position, adapt the activity to get him calmed down, get him back on board the activity	• Clinicians adapt nonverbal communication to the child • Tone of voice is adapted to the child • The activity is adapted to the child • Position of the clinician is adapted to the child • The child clinician connection supports the child to do the activities
Meg: Something we didn't mention, the device was always close to the children so even	• The AAC device is always close to the child
Jo: Yes	
Meg: When they changed table top, on the floor, on the shelf, the device was always quickly adapted and taken towards the child. It was always close	• The AAC device is always close to the child
Jo: ((in overlap)) It was always available	• The AAC device is always close to the child
Meg: Within reach	• The AAC device is always close to the child

Andy: Even the child was taken in consideration, even for example sometimes one of the children didn't actually want to participate in the session and the therapist adapted the whole structured environment, into a more enticing fun environment, he usually likes the ball so let's entice him with the ball, play with the ball, play with the ball, so giving him, adapting the whole structure of the thing to get him enticed, to come with you, rather than boom boom get him into the activities	• Room adaptations are planned according to the child • Fun activities are used to entice • Taking the child's lead helps to establish a connection
Meg: And I felt the therapists were taking time to get to know the children, and looking and seeing, observing what they were doing, and by observing them and seeing what they were doing it would give them insight into how they can adapt the sessions for next time	• Clinicians take time to understand children with ASC • Understanding children with ASC provides insight into how to adapt sessions
Moderator: Alright	
Meg: Emmmmm through just observing the children and doing their thing	• Understanding children with ASC provides insight into how to adapt sessions
Andy: They are also challenging some of the children, so you're at one point and then you challenge them with a different activity to see how he reacts, get him for next time, errrr, that was quite evident with puzzles kind of thing and relaxation techniques, the two extreme, so you might try something, whether challenging him for more or introducing a relaxation technique to calm him down and	• Understanding children with ASC provides insight into how to adapt sessions • New activities help the clinician learn about the child • Relaxation techniques can be used to calm a child down

get him back to you, so there were two particular things which are quite interesting to see and they got into them, they adapted so quickly, so flexibly that you wouldn't even, I mean cos we were there to observe particular things that's why we see them because otherwise from the child's side (.) OK (.) I don't want to do nothing and then	
Moderator: There was a flow	
Andy: And then you entice with the ball, he's all over the place with the ball, then the relaxation techniques to get him back to where you want, so it was so smooth, the transition between this, the adaptation was very smooth	• Activities should flow from one to another • Relaxation techniques can be used to calm a child down
Meg: And also emmm one of the children was very anxious and they were preparing a lot of things from before and making him feel, that they know, somehow they were making it look like, the child knew what the therapist was expecting, I mean, they were constant on the way they were presenting him with the things they were very fast, they didn't leave him on his own, he didn't have time to get anxious, they were constantly providing him with things and keeping him like active, saying (.) listen (.) this is what we're going to do next (.) emmmmm which I think had an effect on the outcome of the	• Speed of activities can prevent anxiety • Predictability in session can prevent anxiety
Andy: Even who took the lead varied, therapist adapted (.) who's taking the lead according to the child (.) ummmmmm (.) some children	• Children respond differently to different clinicians

were responding better when led by one person	
Moderator: OK	
Andy: And I noticed that another child was (.) was on board more when someone else led and the therapists were shifting who led the session for that particular activity, very smooth, stepping out and then someone else stepping in and leading the session and you can see that the children respond differently when different therapists lead the session, it could be the way they look, sympathy from the child's side, it could be the way (.) character wise, the tone of voice and your approach, could be the way you position but the children were responding yes, differently to when one particular therapist was leading than the other	• Children respond differently to different clinicians • Clinician's communication may affect connection • Clinician's use of clinical strategies may affect connection
Meg: ((inaudible)) was very common, they were trying, they were using the same toys but the way they were presented was different to try and keep the children engaged	• Reinforcers are used in different ways to keep the child engaged
Moderator: OK ((pause)) so to round off (.) of all the things we talked about what do you think was the most important thing and why?	
Andy: Emmmm, one big thing that I noticed is the use of self when carrying out the session with the child, you could see, you could feel, even more, you can feel this even more when you're observing than when you're doing the session, ummmmmm the way you as a person	• The use of the self is important in creating a connection with the child • The use of the self involves many elements which support a connection

change your connection with the child, the way you present activities, the way you use your voice, the way you change without even thinking about it, your position, your voice, your energy in the session, when you see it that way it's unbelievable, we change as a therapists using yourself both physically	
Moderator: It's not what you do, is how you do it	
Andy: Exactly, it's like physically the way you position to guide the child, the way you add your voice to that physical position, the way you use your eyes and proximity with the child makes a whole big change in the way you present a session	• Position of the clinician guides the child • Voice and positioning are used together • Use of nonverbal communication affects the presentation of a session
Jo: And I think even if you are going into a session keeping in your mind that you are going to let the child lead I think it was important as well for the therapist, it was very evident to be flexible, to adjust accordingly, ummmmI think that was very important you know, because if you are…if, like you said, it's going to be child centred but (.) emmmmm (.) adult led emmmmm (.) you, you have to be flexible I mean	• Following the child's lead is used • Being flexible in use of strategies is part of following the child's lead • Flexibility is key to being child centred but adult led
Meg: Preparation, they were always prepared beforehand the room ready so the child is going in and the child is there everything is prepared	• There is preparation for sessions
Jo: Ehe (Maltese: indicates agreement)	

Meg: Even the actual prompting	• A prompt hierarchy is used during intervention
Jo: The actual prompting was very evident, yes and important	• A prompt hierarchy is used during intervention
Andy: And consistent towards the protocol	• It is important to follow the prompt hierarchy
Meg: Exactly	
Andy: It was all throughout. This is the goal, we have to be consistent towards, Ok, child led, very flexible, errr, we adapt change but the consistency and repetition towards the protocol was there underlying and you use yourself accordingly, you change it up, but leading towards your main aim	• Supported achievement of therapy goals • It is important to follow the prompt hierarchy • The use of the self supports the achievement of the goal • The clinician needs to be flexible during interventions
Moderator: I have a couple of questions, you have touched on it a little bit that you noticed that the therapists maybe communicated differently with different kids, you mentioned child 1 and child 4, so N and L, maybe it will help you if you think about them in terms of the actual kids themselves, so N was child 1, L was child 4, M was child 3 and J was child 2, right, would you have anything more you want to say about that? About how the therapists communicated, be it verbally or nonverbally?	
Andy: Child specific?	
Moderator: Hmmmm (yes)	
Meg: With regards to child 2 and child 3 so?	

Moderator: Whatever you want to say that you noticed, you did mention child 3 (M I think) was under aroused or passive as you put it, I mean, and you said that the therapists were more assertive with him, and then you said in relation to L	
Meg: ((in overlap)) L was more	
Moderator: ((in overlap)) That he was very anxious child and that they were using calming, do you have anything more to say about any of that for any of the children	
Meg: I think with regards to J	
Jo: The sensory needs, I think the therapists were addressing them quite well for instance on one occasion the therapists wanted to play with the ball but emmm one of the therapists used actually used the ball to apply pressure, and I can't exactly remember what happened but it was, it was something like that so so (.) emmmmm (.) so yes with J that was one thing I noticed (.) emmmmm which	• Sensory needs are addressed in interventions • Typical play activities are used to address sensory needs
Andy: The only thing with J is that identified that before, If they didn't tackle his sensory issues they it was a big wall getting to the goal	• Sensory processing difficulty can affect a child's progress in learning to use AAC systems • Sensory processing issues have to be tackled as part of the AAC intervention process
Jo: The sensory issues were present throughout I think it was, for me J was the	• Sensory processing difficulty can affect a child's

most evident and emmmmm his sensory issues	progress in learning to use AAC systems
Andy: Using calming strategies with him	• Calming strategies were sometimes used as part of the intervention process
Jo: Ehe (Maltese: indicates agreement) it helped	
Andy: Modifying the environment on the spot to get him what he needs	• Some children need environmental modifications embedded within the AAC interventions • Speed of adaptability is evident
Meg: We observed J in one instance with one of you, I don't remember which one it was, he was very tired and they were using a lot of alerting strategies,	• Alerting strategies can be used with a child who is tired
Jo: ((in overlap)) Yes, yes	
Meg: They were I think tickling him	
Andy: So this is the same child, so one session we're trying to calm him down with these breathing exercises and deep pressure and another session they had to adapt and change completely to alerting him up, bringing him up to go in the session (.) What was his name, the other one?	• Children can fluctuate between being hypo and hyper-reactive • The clinician needs to be able to get the child to the 'just right' level
Meg: M	
Andy: M was pretty straightforward, there was a bit of trial and error in the beginning until they identified what he needed but then it was very smooth, very direct	• The child's sensory needs are identified in the beginning

	• Providing interventions that take into account a child's sensory needs will help to achieve the goal • It can take time to identify what a child needs
Jo: I think M was	
Andy: Lots of structure	
Jo: I think M was one of the sharpest when it comes to learning the device	• Children learn to use AAC systems at different speeds
Andy: Yes	
Jo: I think it was M (.) emmmm (.)	
Andy: N needed a lot of alerting, N yes had to be alerted in anything that he does, need to be excited and play as you go along	• Some children need to be alerted • Alerting through fun and excitement is possible
Meg: I think with child 2 as well (J) there was this calm voice and calm approach, he was one of the children that had a lot of bad behaviours, he was hitting, or attempting to bite or run off, so the children the therapists were keeping an expressionless face when they thought he was going to bite or if he pulled their hair to try not to reinforce it more and they, I felt maybe they were trying to modify this behaviour, if he hit, then they applied pressure, they showed him OK, you can do this instead but with re- in terms of voice, was, they weren't using alerting methods, they were keeping it calm	• Some children require a calm approach to support the intervention • Nonverbal communication can be used to manage undesired behaviours • Nonverbal communication can be used to achieve other goals

Jo: And with M I noticed that emmmmm that for example they would notice that he would need some breaks and usually they would give him a break between one puzzle and the other and just, to walk a bit around the room and then he would sit right down and continue the puzzle so emmm I think for them that they realised that listen, we need to give M a break between one puzzle and the other so..	• Some children were given movement breaks during the intervention • Following the child's lead is used
Andy: The correspondence checks I think in child 4 started way before because I think he was one of the children that grabbed the concept of the project very quickly, so correspondence checks I mean that started pretty earlier to make sure that he, is he just guessing because he's very rigid or is it because he is really understanding and asking for what he wants... but when it comes to child 4 there was very clear communications strictly to the protocol, he did it himself which was very good in a way, and was very strict in what he wanted and gradually reducing the prompts to zero in the same session so starting from a couple of physical prompts down to zero in the same session, I think he was the one tolerating this the easiest, kind of thing ((pause)) (looking at notes) J then was different, J fluctuated a lot in my opinion, from what I saw he did fluctuate a lot (.) so from one moment he's there and you can sabotage an activity and introduce my turn, your turn,	• Clinicians fade prompts according to the child • Correspondence checks were used more as the child progressed • Correspondence checks are used when the child is starting to achieve the AAC goal • It is important to follow the prompt hierarchy • Children can fluctuate between activities • Some children need to be alerted • Children can fluctuate between being hypo and hyper-reactive • Creating communication opportunities is used as a strategy

the next time he's (.) and you have to alert him to get him there and to get his attention	
Moderator: So I was asking for clarification on the actual interaction itself, the communication	
Jo: (Looking through notes) ah alright, I think as M said, I mean we were, emmmm the level of alertness in the therapists' voice altered depending to to to the child, for example when she, like she said emm when J was feeling a bit low and and they had to use a a voice that was a bit more alert, so I think that was quite evident	• An alerting tone of voice can be used with children who are hypo-reactive • Clinicians adapt the tone of the voice according to the child's sensory state
Andy: N, his communication was much more alerting, higher pitched voice, much more exciting, much more variety from one thing to the other, lots of spontaneity moving towards from one activity to the other, so that did vary as well ((pause)) (Looking through notes) even the structure level was different, how much the session was structured from one child to the other differed, we mentioned this before, for the puzzle guy, very structured	• An alerting tone of voice can be used with some children • Some children require many exciting activities • Some children require more structure in sessions than others
((General laughter))	
Meg: Puzzle guy	
Andy: I'm very bad with names so I remember children with a particular characteristic so yes ummm he could handle structure and they gave structure to get him to the goal of the session. Other children like J where so many things were interfering the communication changed and less structure was used (.) and	• Session structure is planned individually for each child • Children can fluctuate between sessions • Other issues can interfere with learning to use an AAC system

that's something that you could realise. The other two were pretty similar I think, they both fluctuated from one [session to the other]	• Less structure is used when children have other issues which interfere with their ability to learn
Meg: ((in overlap)) I think J and L were pretty similar	
Jo: J was a bit	
Meg: J (.) .errr except when he was going to sleep	
Jo: Yes	
Meg: But I think in terms of behaviour	
Jo: J was a bit like that and a bit more like that and L was all over the place, no? In what sense more similar?	
Meg: the way he goes about things	
Andy: their approach	
Jo: ((in overlap)) their approach, yes, OK	
Meg: ((in overlap)) Even the way they were working, I felt that with J and L they were very fast and constantly doing stuff but with N and M the feeling was more like soft and flowy	• Some children need a faster pace • Some children need a soft approach
Andy: ((in overlap)) There was more structure, more pace	• Some children need a faster pace • Some children require more structure in sessions than others
Meg: But with J and L it was more boom, boom, boom (snapping fingers) kind of fast paced	• Some children need a faster pace

Jo: ((in overlap)) Yes, it had to be at a faster pace	• Some children need a faster pace
Andy: Up and down the most I saw I think was J, was impressed, his level	• Children can fluctuate between sessions
Meg: But J's level	
Andy: Unbelievable (.) the others they were more a bit more (.) there was a kind of pattern, so even communication, even if it at this point we reduce the physical prompting then it was consistent where we're shifting away from physical prompting to verbal prompting, there was like consistency OK we're at this level, now what's next? But when it comes to J I think I saw ups and downs going back to square one multiple times resorting back to physical prompting at some point with his mood	• Children's progress can fluctuate between sessions • Some children make consistent progress • Sometimes it is necessary to go back in the prompting hierarchy • You have to on trying to make things work in interventions
Assistant Moderator: OK, I'm just going to sum up what I'm hearing from you, I'm hearing that on the one hand because I had already written down adaptability and flexibility before we had gotten to that question, because that was coming up as a very strong theme	
Meg: Uhmmmmm (agreement)	
Assistant Moderator: Yet on the other hand I'm hearing that we were also quite rigid (laughs), and mainly in respect of the protocol and getting to where we wanted to get to which was our final goal, but then we were very, from what I'm hearing from you was that we were quite adaptable we used flexibility In	

many different aspects including providing fun and novelty and making it a fun interaction, emmm the interactions themselves and how we interacted both in terms of our communication, which was verbal or nonverbal, emmmm the equipment that we used, emmmm the sen- the use of sensory motor room and or strategies (.) emmmmm (.) we were flexible in terms of providing opportunities for communication, and underlying this I think was the idea I think that if we didn't have motivators you mentioned this MANY times, that that was almost like the motivators, being able to connect were like I'm hearing them as (.) base foundations let's put it that way (.) foundations	
Jo: Yes	
Andy: ((in overlap)) Yes	
Assistant Moderator: That are needed to build on (.) emmmmm (.) also I liked that you spoke about how we used flexibility to challenge but altern- at other times	
Andy: To go down	
Assistant Moderator: To go down so I thought that was interesting and yeah I suppose we did have quite a rigid approach sometimes	
Andy: What I see is two binaries (.) like (laughs) the way you have the goal that you want to reach so obviously you need to keep up with that and be rigid but then you have	• Supported achievement of therapy goals

the therapeutic arts, that's the art of therapy, you need to change and adapt in order to get to your goal so if you want a summary	• It is necessary to be rigid yet flexible in providing AAC interventions • Clinician needs to adapt according to the child to achieve the goal
Assistant Moderator: Yeah, no no that's exactly, that was the theme what I picked up, yes	
Andy: The flexibility, the changing and that, but obviously always doing that in order to keep, to get to the goal	• Clinician needs to adapt according to the child to achieve the goal • Supported achievement of therapy goals
Assistant Moderator: Thank you everyone for taking part in the study. I'll stop recording now	

60 minutes 53secs

Data coded for 200 codes

1. Children with ASC are not all the same
2. You can establish a connection more easily with some children with ASC than others
3. When you establish a connection you can feel it
4. You need to establish a connection to successfully implement intervention
5. Taking the child's lead helps to establish a connection
6. You have to keep trying to establish a connection
7. Trust is important to form a connection
8. The child's comfort is important to form a connection
9. A connection with a child with ASC may not be obvious
10. Some reinforcers can get in the way of forming a connection
11. Strong reinforcers may need to be avoided in interventions
12. Reinforcers can be helpful to form a connection with a child with ASC
13. You need to try out different reinforcers to find out what works best for interventions
14. It can be difficult to connect with a child with ASC
15. Recognising when a child with ASC approaches you he is beginning to establish a connection with you
16. Sometimes a connection may be suddenly established
17. Family involvement can help to establish a connection
18. Involving the school can be helpful
19. The way you approach a child can impact on establishing a connection
20. The clinician's communication skills play a role in establishing a connection
21. Offering choices can support connections to be formed
22. Connecting with the child does not mean that s/he is free to do what he wants
23. Techniques have impact
24. Following the child's lead is used
25. Having fun supports the formation of connections

26. Being demanding can stop the formation of connections between child and clinician
27. It is possible to have fun in any activity
28. Being too rigid can impede the formation of connections
29. Fun activities can be more effective than activities where a child has to sit down
30. Stimulating toys can be helpful with a child with ASC
31. Providing rewards is important
32. Negotiating with the child is important in interventions
33. Different environments can impact forming connections differently
34. Clinicians rapidly change between one strategy and another
35. Strategies are selected according to how the child responds
36. Being flexible in use of strategies is used
37. Strategies are selected according to how the child responds
38. A prompt hierarchy was used during intervention
39. Prompts are faded and reintroduced in interventions
40. Sessions are structured
41. The approach varies for each child
42. Different levels of prompts are required
43. The clinician is responsive
44. You have to find a way to make things work in interventions
45. The clinician's nonverbal communication plays a role in intervention
46. AAC goals were established
47. Supported achievement of therapy goals
48. Facial expressions played a part in the interventions
49. The tone of voice played a part in the interventions
50. The eyes were used in the interventions
51. Looking at what the child is interested in supports a connection
52. Boundary setting using furniture can be helpful
53. The use of the clinician's body varied according to the child
54. The clinician uses his/her body during interventions

55. The clinician shows that s/he is expecting the child to respond
56. We should give time for the child to respond
57. The child can respond in many ways
58. Talking too much can overload a child
59. You need to wait longer with some children than others
60. Tone of voice can be used differently in interventions
61. An alerting tone of voice can be used with children who are hypo-reactive
62. Calling a child's name can be used to alert a hypo-reactive child
63. Touch can be used to alert a hypo-reactive child
64. Touch can be used to calm
65. Touch can be used to alert
66. Touch and physical guidance can be used to support comprehension
67. Nonverbal communication can be used to manage undesired behaviours
68. Nonverbal communication can be used to achieve other goals
69. Pointing is used to support interventions
70. Pointing is used in conjunction with words
71. Pointing can be used to support comprehension during interventions
72. Interpreting vocalisations is used during interventions
73. A total communication approach is used during interventions
74. Verbal cues are used during interventions
75. Materials are used in interventions
76. A combination of strategies is required for successful interventions
77. Tone of voice can be used to alert
78. Tone of voice can be used to calm
79. The clinician's communication skills play a role in interventions
80. Soft voice can support joint attention
81. Praise is used in intervention
82. Repeating the child's communication attempts with the AAC device is reinforcing
83. The clinician uses short direct instructions during the intervention

84. Expanding on the child's communication attempts with the AAC device is used during interventions
85. Sessions targeting AAC skills can also target other skills
86. Children are given verbal encouragement during interventions
87. The child clinician connection supports the child to do the activities
88. Other communicative functions apart from requesting may be modelled through expanding on the child's communication attempts with the AAC device
89. Creating communication opportunities is used as a strategy
90. Sabotaging activities creates communication opportunities
91. The use of verbal cues depends on the child's performance
92. Children's progress can fluctuate between sessions
93. Nonverbal and verbal communication used by clinicians is intertwined
94. Communication is adapted to the child in real time
95. Clinicians describe what the child is doing with the AAC device
96. Adapting to the child's native language is used
97. The tone of voice is used in interventions
98. Tone of voice is adapted to the child
99. A calming tone of voice used with children who are hyper-reactive
100. Comprehension is supported during interventions
101. The clinician continuously assesses and adapts accordingly
102. Rhythm and melody is used during interventions
103. Time is needed to identify reinforcers with some children
104. The clinician adapts language input according to the child
105. Comprehension skills vary in children with ASC
106. AAC goals are clear
107. Reinforcers can be helpful to work on intervention goals in AAC interventions
108. Reinforcers are different for different children
109. Intervention is adapted according to the child

110. Trial and error is sometimes required to successfully implement interventions successfully with some children
111. The clinician needs tobe adaptable to successfully implement interventions
112. Some children need more prompting than others
113. Clinicians wait for children to initiate
114. Facial expressions were less used with children who were hyper-reactive
115. Facial expressions were used more with some children
116. Clinicians fade prompts according to the child
117. Clinicians alter the level of prompting
118. There is more physical prompting at the beginning of interventions
119. Session structure is planned individually for each child
120. Some children need sensory motor input prior to AAC interventions
121. Some children need environmental modifications embedded within the AAC interventions
122. The clinician needs to be flexible during interventions
123. Changes to how the vocabulary is displayed may need to be made
124. Getting face to face is used in interventions
125. A range of communicative partners are used
126. Checking for generalisation of skills is used
127. Choices are always provided
128. Activities should flow from one to the other
129. Correspondence checks are used
130. Correspondence checks are used more as the child attends more intervention sessions
131. Correspondence checks are used to check the child has acquired the skill
132. Correspondence checks are important
133. Clinicians communicate together in sessions
134. Clinicians work together

135. Clinicians troubleshoot strategies together
136. It is important to follow through the prompt hierarchy
137. Family members are involved in intervention sessions
138. Environmental modifications are used
139. Speed of adaptability is evident
140. AAC interventions are child oriented
141. Room adaptations are planned according to the child
142. Toys chosen according to the child
143. Environment is not overwhelming
144. Clinicians adapt nonverbal communication to the child
145. The activity is adapted to the child
146. Position of the clinician is adapted to the child
147. The AAC device is always close to the child
148. Fun activities are used to entice
149. Clinicians take time to understand children with ASC
150. Understanding children with ASC provides insight into how to adapt sessions
151. New activities help the clinician learn about the child
152. Relaxation techniques can be used to calm a child down
153. Speed of activities can prevent anxiety
154. Predictability in session can prevent anxiety
155. Children respond differently to different clinicians
156. Clinician's use of communication may affect the connection
157. Clinician's use of clinical strategies may affect the connection
158. Reinforcers are used in different ways to keep the child engaged
159. The use of the self is important in creating a connection with the child
160. The use of the self involves many elements which support a connection
161. Position of the clinician guides the child
162. Voice and positioning are used together

163. Use of nonverbal communication affects the presentation of a session
164. Being flexible in use of strategies is part of following the child's lead
165. Flexibility is key to being child centred but adult led
166. There is preparation for sessions
167. The use of the self supports the achievement of the goal
168. Sensory needs are addressed in interventions
169. Typical play activities are used to address sensory needs
170. Sensory processing difficulty can affect a child's progress in learning to use AAC systems
171. Sensory processing issues have to be tackled as part of the AAC intervention process
172. Calming strategies were sometimes used as part of the intervention process
173. Alerting strategies can be used with a child who is tired
174. Children can fluctuate between being hypo and hyper-reactive
175. The clinician needs to be able to get the child to the 'just right' level
176. The child's sensory needs are identified in the beginning
177. It can take time to identify what a child needs
178. Providing interventions that take into account a child's sensory needs will help to achieve the goal
179. Children learn to use AAC systems at different speeds
180. Some children need to be alerted
181. Alerting through fun and excitement is possible
182. Some children require a calm approach to support the intervention
183. Some children were given movement breaks during the intervention
184. Correspondence checks were used more as the child progressed
185. Correspondence checks are used when the child is starting to achieve the AAC goal
186. Children can fluctuate between activities

187. Clinicians adapt the tone of the voice according to the child's sensory state
188. An alerting tone of voice can be used with some children
189. Some children require many exciting activities
190. Some children require more structure in sessions than others
191. Children can fluctuate between sessions
192. Other issues can interfere with learning to use an AAC system
193. Less structure is used when children have other issues which interfere with their ability to learn
194. Some children need a faster pace
195. Some children need a soft approach
196. Some children make consistent progress
197. Sometimes it is necessary to go back in the prompting hierarchy
198. It is necessary to be rigid yet flexible in providing AAC interventions
199. You have to on trying to make things work in interventions
200. Clinician needs to adapt according to the child to achieve the goal

Study 4: From codes to sub themes

Codes	Subthemes
• AAC interventions are child oriented • Flexibility is key to being child centred but adult led • Intervention is adapted according to the child • Clinician needs to adapt according to the child to achieve the goal • The approach varies for each child • Intervention is adapted according to the child • Strategies are selected according to how the child responds • Being flexible in use of strategies is used • Being flexible in use of strategies is part of following the child's lead • The clinician needs to be flexible during interventions	• *Interventions are child oriented*
• Providing interventions that take into account a child's sensory needs will help to achieve the goal • Children can fluctuate between being hypo and hyper-reactive • Some children need to be alerted • Some children require a calm approach to support the intervention • Some children were given movement breaks during the intervention	• *Interventions consider sensory processing needs*
• Touch and physical guidance can be used to support comprehension	• *Personalised interventions*

• Pointing can be used to support comprehension during interventions • Comprehension is supported during interventions • Session structure is planned individually for each child • Some children require more structure in sessions than others • Less structure is used when children have other issues which interfere with their ability to learn • The activity is adapted to the child • Some children require many exciting activities • Some children need a faster pace • Some children need a soft approach • Room adaptations are planned according to the child • Sessions targeting AAC skills can also target other skills • Nonverbal communication can be used to achieve other goals • Nonverbal communication can be used to manage undesired behaviours	
• A combination of strategies is required for successful interventions • The clinician is responsive • The clinician continuously assesses and adapts accordingly • The clinician needs to adaptable to successfully implement interventions • It is necessary to be rigid yet flexible in providing AAC interventions	• *Clinical decision-making is necessary*

• AAC goals were established • Supported achievement of therapy goals • AAC goals are clear • The use of the self supports the achievement of the goal • Sessions are structured • There is preparation for sessions • Techniques have impact • Following the child's lead is used • Interpreting vocalisations is used during interventions • A total communication approach is used during interventions • The clinician shows that s/he is expecting the child to respond • We should give time for the child to respond • Getting face to face is used in interventions • Position of the clinician guides the child • Clinicians wait for children to initiate • Use of nonverbal communication affects the presentation of a session • Creating communication opportunities is used as a strategy • Sabotaging activities creates communication opportunities • Choices are always provided • Speed of activities can prevent anxiety • Predictability in session can prevent anxiety • Relaxation techniques can be used to calm a child down	

• Alerting strategies can be used with a child who is tired • Calming strategies were sometimes used as part of the intervention process • Environmental modifications are used • Environment is not overwhelming • Boundary setting using furniture can be helpful • Providing rewards is important • Negotiating with the child is important in interventions • Children are given verbal encouragement during interventions • A prompt hierarchy was used during intervention • It is important to follow through the prompt hierarchy • Prompts are faded and reintroduced in interventions • Different levels of prompts are required • Some children need more prompting than others • Clinicians fade prompts according to the child • Sometimes it is necessary to go back in the prompting hierarchy • Clinicians alter the level of prompting • There is more physical prompting at the beginning of interventions • Materials are used in interventions • Reinforcers are used in different ways to keep the child engaged	

• Reinforcers can be helpful to work on intervention goals in AAC interventions • Correspondence checks are important • Correspondence checks are used • Correspondence checks are used more as the child attends more intervention sessions • Correspondence checks were used more as the child progressed • Correspondence checks are used when the child is starting to achieve the AAC goal • Correspondence checks are used to check the child has acquired the skill • The AAC device is always close to the child • Repeating the child's communication attempts with the AAC device is reinforcing • Expanding on the child's communication attempts with the AAC device is used during interventions • Other communicative functions apart from requesting may be modelled through expanding on the child's communication attempts with the AAC device • Clinicians describe what the child is doing with the AAC device	
• Clinicians rapidly change between one strategy and another • Speed of adaptability is evident • Activities should flow from one to the other • Trial and error is sometimes required to successfully implement interventions successfully with some children	• *Clinical experience supports implementation*

• It is possible to have fun in any activity • Fun activities can be more effective than activities where a child has to sit down • Fun activities are used to entice • Alerting through fun and excitement is possible	• *Fun and play fosters engagement*
• You have to keep trying to establish a connection • It can take time to identify what a child needs • Children's progress can fluctuate between sessions • You have to find a way to make things work in interventions • You need to try out different reinforcers to find out what works best for interventions	• *Persistence is needed*
• The clinician's communication skills play a role in intervention • The clinician's nonverbal communication plays a role in intervention • Nonverbal and verbal communication used by clinicians is intertwined • The tone of voice played a part in the interventions • The tone of voice is used in interventions • Rhythm and melody is used during interventions • Facial expressions played a part in the interventions • The eyes were used in the interventions • The clinician uses his/her body during interventions • Pointing is used to support interventions	• *The clinician uses communication as an intervention component*

• Pointing is used in conjunction with words • Verbal cues are used during interventions • Soft voice can support joint attention • The clinician uses short direct instructions during the intervention • Voice and positioning are used together	
• Communication is adapted to the child in real time • Clinicians adapt nonverbal communication to the child • The use of the clinician's body varied according to the child • Position of the clinician is adapted to the child • Tone of voice can be used differently in interventions • Tone of voice is adapted to the child • The use of verbal cues depends on the child's performance • Clinicians adapt nonverbal communication to the child • An alerting tone of voice can be used with some children • Facial expressions were used more with some children • You need to wait longer with some children than others • The clinician adapts language input according to the child • Adapting to the child's native language is used • A range of communicative partners are used	• *Clinician's communication is adapted to the child*

• Clinicians adapt the tone of the voice according to the child's sensory state • An alerting tone of voice can be used with children who are hypo-reactive • Calling a child's name can be used to alert a hypo-reactive child • A calming tone of voice used with children who are hyper-reactive • Touch can be used to alert a hypo-reactive child • Touch can be used to alert a hypo-reactive child • Touch can be used to calm • Touch can be used to alert • Facial expressions were less used with children who were hyper-reactive • Tone of voice can be used to alert • Tone of voice can be used to calm	• *Communication is adapted to sensory processing pattern*
• Family involvement can help to establish a connection • Family members are involved in intervention sessions • Involving the school can be helpful • Clinicians communicate together in sessions • Clinicians work together • Clinicians troubleshoot strategies together	• *Communicating with others is important*
• You need to establish a connection to successfully implement intervention • The child clinician connection supports the child to do the activities • Understanding children with ASC provides insight into how to adapt sessions	• *Connecting is important*

• Some reinforcers can get in the way of forming a connection • Strong reinforcers may need to be avoided in interventions	• *Materials in the session can influence forming a connection*
• It can be difficult to connect with a child with ASC	• *Child attributes can influence forming a connection*
• Being demanding can stop the formation of connections between child and clinician • Being too rigid can impede the formation of connections	• *The clinician can influence the formation of a connection*
• Recognising when a child with ASC approaches you he is beginning to establish a connection with you • When you establish a connection you can feel it • A connection with a child with ASC may not be obvious	• *The clinician recognises the formation of a connection*
• The clinician's communication skills play a role in establishing a connection • Clinician's use of communication may affect the connection • The use of the self is important in creating a connection with the child • The use of the self involves many elements which support a connection • Clinician's use of communication may affect the connection	• *The clinician's communication skills support the formation of a connection*
• Taking the child's lead helps to establish a connection	• *The clinician uses clinical strategies to connect*

• The way you approach a child can impact on establishing a connection • Offering choices can support connections to be formed • Looking at what the child is interested in supports a connection • Clinicians take time to understand children with ASC	
• Having fun supports the formation of connections • Clinician's characteristics may affect connection	• *Fun supports connection*
• You can establish a connection more easily with some children with ASC than others • Sometimes a connection may be suddenly established	• *Child factors influence a connection*
• Trust is important to form a connection • The child's comfort is important to form a connection • Different environments can impact forming connections differently • Reinforcers can be helpful to form a connection with a child with ASC	• *There are enabling factors in forming a connection*
• Sensory processing difficulty can affect a child's progress in learning to use AAC systems	• *Sensory processing difficulties can impact on AAC learning*
• The child's sensory needs are identified in the beginning	• *Assessment to identify sensory processing needs*

• Sensory needs are addressed in interventions • Typical play activities are used to address sensory needs • Sensory processing issues have to be tackled as part of the AAC intervention process • Some children need sensory motor input prior to AAC interventions • Some children need environmental modifications embedded within the AAC interventions	• *Sensory processing difficulties addressed alongside AAC interventions*
• Children with ASC are not all the same • Comprehension skills vary in children with ASC	• *Heterogeneity within the ASC group*
• Children can fluctuate between sessions • Children can fluctuate between activities • The child can respond in many ways • Children respond differently to different clinicians	• *There can be variation in how children with ASC respond*
• Children learn to use AAC systems at different speeds • Some children make consistent progress	• *There can be variation in progress*
• Reinforcers are different for different children • Toys chosen according to the child	• *There is variation in motivators*

Study 4: From subthemes to themes

Theme 1: The clinician as a human tool, the enabler

Codes	*Sub Themes*	*Theme*
1. *Interventions are child oriented* 2. *Interventions consider sensory processing needs* 3. *Persistence is needed* 4. *Personalised interventions* 5. *Fun and play foster engagement*	1. *Clinician's attributes*	The clinician as a human tool, the enabler
6. *Clinical decision-making is necessary* 7. *Clinical experience supports implementation*	2. *Clinical skills and knowledge*	
8. *The clinician uses communication as an intervention component* 9. *The clinician's communication is adapted to the child* 10. *Communication is adapted to the child's sensory processing needs*	3. *Communication*	

11. *Communicating with others is important*		

Theme 2: The child-clinician bond fundamental to the implementation of AAC interventions

Codes	*Sub Themes*	*Theme*
1. *Connecting is important* 2. *The clinician recognises the formation of a connection* 3. *The clinician's communication skills supports the formation of connections* 4. *The clinician uses clinical strategies to connect* 5. *Fun supports connection* 6. *Child factors influence a connection* 7. *There are some enabling factors in forming a connection* 8. *Materials in the session can influence forming a connection* 9. *Child attributes can influence forming a connection*	1. *Connecting is important* 2. *Clinician's active involvement* 3. *Barriers to connecting*	The child-clinician bond fundamental to the implementation of AAC interventions

10. *The clinician can influence the formation of a connection*		

Theme 3: Diversity impacts clinical outcomes in AAC interventions

Codes	*Sub Themes*	*Theme*
1. *Heterogeneity within the ASC group* 2. *Sensory processing difficulties can impact on AAC learning* 3. *Assessment to identify sensory processing needs* 4. *Sensory processing difficulties addressed alongside AAC interventions*	1. *Child characteristics* 2. *Address sensory processing needs*	Diversity impacts clinical outcomes in AAC interventions